U.S. DEPARTMENT OF COMMERCE

PB80-175607

Advanced Combustion Systems for Stationary Gas Turbine Engines Volume II. Bench Scale Evaluation

Pratt and Whitney Aircraft Group
West Palm Beach, FL

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Jan 80

U.S. Department of Commerce
National Technical Information Service
NTIS

PB80-175607

United States
Environmental Protection
Agency

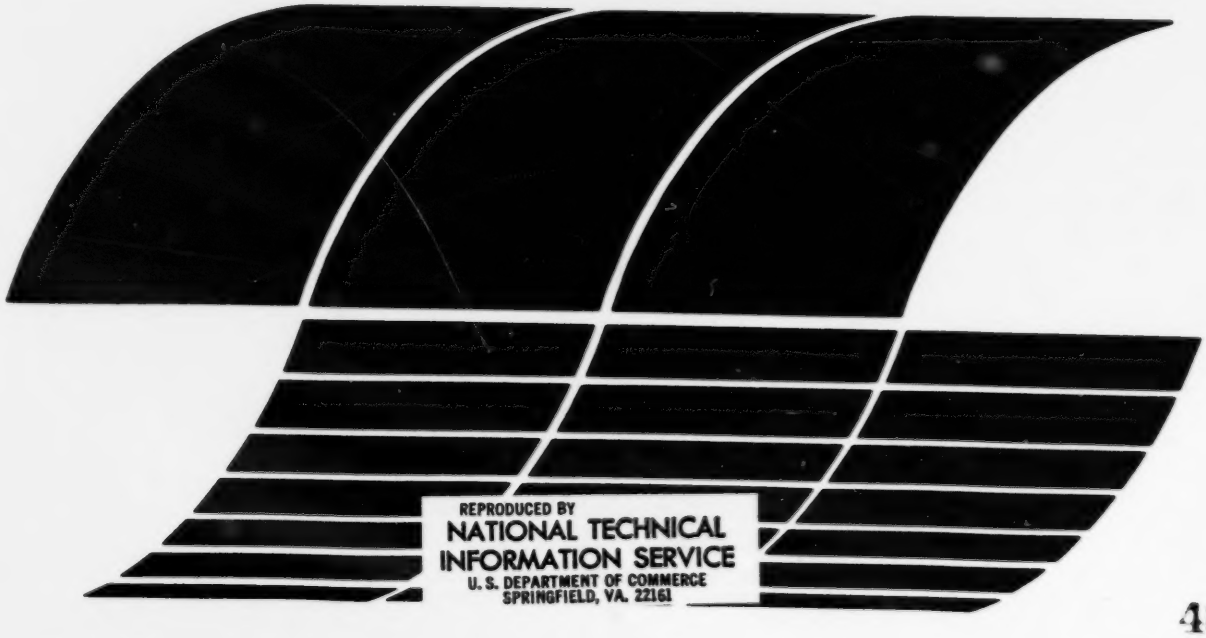
Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

EPA-600/7-80-017b
January 1980

EPA

Advanced Combustion Systems for Stationary Gas Turbine Engines: Volume II. Bench Scale Evaluation

Interagency Energy/Environment R&D Program Report



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

EPA REVIEW NOTICE

This report has been reviewed by the participating Federal Agencies, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-600/7-80-017b		PB 80 175607

4. TITLE AND SUBTITLE	5. REPORT DATE
Advanced Combustion Systems for Stationary Gas Turbine Engines: Volume 2. Bench Scale Evaluation	January 1980
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
R. M. Pierce, S. A. Mosier, C. E. Smith, and B. S. Hinton	FR-11405
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Pratt and Whitney Aircraft Group United Technologies Corporation P.O. Box 2691 West Palm Beach, Florida 33402	INE829
	11. CONTRACT/GRANT NO.
	68-02-2136
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711	Final; 9/76 - 1/78
	14. SPONSORING AGENCY CODE
	EPA/600/13

15. SUPPLEMENTARY NOTES IERL-RTP project officer is W.S. Lanier, Mail Drop 65, 919/541-2432.

16. ABSTRACT The reports describe an exploratory development program to identify, evaluate, and demonstrate dry techniques for significantly reducing NOx emissions from stationary gas turbine combustors. (Volume 1 documents the research activities leading to selection of 26 combustor design concepts which could potentially meet the program goals.) Volume 2 documents the Phase II bench-scale evaluation of those concepts to experimentally evaluate their emission reduction potential. Results from the testing program identified two design approaches capable of significant emission reduction. A staged centertube design, relying on burner operation near the lean blowout limit, gave low NOx and CO emissions on clean No. 2 fuel oil, but was ineffective for fuels containing bound nitrogen. A rich-burn/quick-quench (RB/QQ) design, producing a fuel-rich primary zone and quickly quenching the effluent from that region to the high overall excess air conditions required by the gas turbine cycle, successfully controls NOx from both thermal and fuel-bound sources while maintaining low CO emissions for high thermal efficiency. The RB/QQ concept was selected for scaleup to full size hardware in Phases III and IV.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Control	13B
Gas Turbine Engines	Stationary Sources	21E
Stationary Engines	Unburned Hydrocarbons	21K
Nitrogen Oxides	Combustor Design	07B
Carbon Monoxide	Staged Combustion	
Hydrocarbons	Dry Controls	07C
Combustion	Fuel Nitrogen	21B
Combustion Chambers		
Flammability		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public	Unclassified	
	20. SECURITY CLASS (This page)	22. PRICE
	Unclassified	

EPA Form 2220-1 (9-73)

EPA-600/7-80-017b

January 1980

Advanced Combustion Systems for Stationary Gas Turbine Engines: Volume II. Bench Scale Evaluation

by

R.M. Pierce, S.A. Mosier, C.E. Smith,
and B.S. Hinton

Pratt and Whitney Aircraft Group
United Technologies Corporation
P.O. Box 2691
West Palm Beach, Florida 33402

Contract No. 68-02-2136
Program Element No. INE829

EPA Project Officer: W.S. Lanier

Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

FOREWORD

This report was prepared by the Government Products Division of the Pratt & Whitney Aircraft Group (P&WA) of United Technologies Corporation under EPA Contract No. 68-02-2136, "Advanced Combustion Systems for Stationary Gas Turbine Engines." It is Volume II of the final report which encompasses work associated with the accomplishment of Phase II of the subject contract from 1 January 1978 through 12 April 1979. The originator's report number is FR-11405.

Contract 68-02-2136 was sponsored by the Industrial Environmental Research Laboratory of the Environmental Protection Agency (EPA), Research Triangle Park, North Carolina under the technical supervision of Mr. W. S. Lanier.

The authors wish to acknowledge the valuable contribution made to this program by Mr. W. S. Lanier, whose skillfull management and insight have been a key factor in the success of the program and of the Rich Burn/Quick Quench combustor design concept.

The Pratt & Whitney Aircraft Program Manager is Mr. Robert M. Pierce; the Deputy Program Manager is Mr. Clifford E. Smith. Mr. Stanley A. Mosier is Technology Manager for Fuels and Emissions Programs at the Government Products Division of Pratt & Whitney Aircraft Group.

Special recognition is due Mr. E. R. Robertson of the Component Design and Integration Group, who was responsible for all drafting, hardware fabrication, and data processing activities. The skillfull assistance of Mr. R. Taber of the Instrumentation Laboratory in setting up and operating the gas analysis equipment is also acknowledged.

TABLE OF CONTENTS

Section		*Page*
I	INTRODUCTION	1
II	DESIGN CONCEPTS	2
	Review of Phase I Concept Identification	2
	Primary Concept Selection	6
	Concept Descriptions	7
III	EXPERIMENTAL PROGRAM	14
	Test Philosophy	14
	Combustor and Rig Hardware	17
	Bench-Scale Combustor Experimental Results	26
	Analytical Model Simulations	197
IV	CONCLUSIONS FROM PHASE II	204
	REFERENCE	205
	APPENDIX A	A-1
	APPENDIX B	B-1
	APPENDIX C	C-1
	APPENDIX D	D-1
	EPA FORM	E-1

LIST OF ILLUSTRATIONS

Figure		*Page*
1	Initial Configuration for Concept No. 1	8
2	Initial Configuration for Concept No. 3	9
3	Initial Configuration for Concept No. 5 With Water as Coolant	10
4	Configuration for Concept No. 5 With Air as Coolant	11
5	Initial Configuration for Concept No. 6	12
6	Initial Configuration for Concept No. 7	12
7	Overview of Bench-Scale Screening Program Test Plan Outline	15
8	Phase II Bench-Scale Test Program	16
9	Typical Screening Cycle	17
10	"Erector Set" Burner Hardware	20
11	Modular Burner Sections Used in the Bench-Scale Test Program	20
12	Bulkhead Plate and "Erector Set" Framework With Combustor	22
13	Bulkhead "Erector Set" Framework and Combustor Installed in Rig	22
14	Schematic Diagram of Bench-Scale Rig	23
15	Photograph of the Bench-Scale Test Rig	23
16	Schematic Diagram of Bench-Scale Rig (Instrumentation)	25
17	Schematic of Gas-Sample Analysis Equipment	27
18	Schematic Diagram of Ammonia Addition System	28
19	Bench-Scale Combustor Scheme 1-1A	30
20	Experimental Hardware Used in the Evaluation of Concept No. 1 — Low Intensity Flame	31
21	Bench-Scale Combustor Scheme 1-2A	32
22	Bench-Scale Combustor Scheme 1-3A	33
23	Bench-Scale Combustor Scheme 1-5A	35
24	Exhaust Emission Data for Scheme 1-5A	36
25	Bench-Scale Combustor Scheme 1-6A	36

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
26	Exhaust Emission Data for Scheme 1-6A	37
27	Bench-Scale Combustor Scheme 1-7A	38
28	Exhaust Emission Data for Scheme 1-7A (No. 2 Fuel)	38
29	Variation in NO_x Concentration and Rate of Bound Nitrogen Conversion With Equivalence Ratio for Concept No. 1 — Low Intensity Flame	39
30	Exhaust Emission Data for Scheme 1-7A	40
31	Bench-Scale Combustor Scheme 1-8A	41
32	Exhaust Emission Data for Scheme 1-8A	42
33	Bench-Scale Combustor Scheme 1-9A	43
34	Exhaust Emission Data for Scheme 1-9A	43
35	Bench-Scale Combustor Scheme 1-10A	45
36	Exhaust Emission Data for Scheme 1-10A	45
37	Bench-Scale Combustor Scheme 3-2A	46
38	Experimental Hardware for Scheme 3-2A	47
39	Bench-Scale Combustor Scheme 3-3A	48
40	Air Heat Exchanger Module Used in the Evaluation of Concept No. 3 — Superlean With Heat Recirculation	48
41	Experimental Hardware for Scheme 3-3A	49
42	Bench-Scale Combustor Scheme 3-4A	51
43	Bench-Scale Combustor Scheme 3-5A	51
44	Bench-Scale Combustor Scheme 3-6A	52
45	Comparison of Variation in NO_x and CO Concentrations With Equivalence Ratio for Two Flameholder Types in Concept No. 3 (Superlean With Heat Recirculation)	53
46	Experimental Hardware Used in the Evaluation of Concept No. 4 — Superlean With Preburner	55
47	Bench-Scale Combustor Scheme 4-1A	56
48	Bench-Scale Combustor Scheme 4-2A	56

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
49	Bench-Scale Combustor Scheme 4-3A	57
50	Bench-Scale Combustor Scheme 4-4A	57
51	Basic Heat Exchanger Module Used in the Evaluation of Corcept No. 5 — Heat Removal	59
52	Array of Four Heat Exchanger Modules	59
53	Alternative Heat Exchanger Hardware Utilizing Air as Coolant	60
54	Bench-Scale Combustor Scheme 5-1A	60
55	Bench-Scale Combustor Scheme 5-2A	61
56	Bench-Scale Combustor Scheme 5-3A	61
57	Bench-Scale Combustor Scheme 5-4A	63
58	Bench-Scale Combustor Scheme 5-5A	63
59	Bench-Scale Combustor Scheme 5-6A	64
60	Bench-Scale Combustor Scheme 5-7A	64
61	Bench-Scale Combustor Scheme 5-8A	65
62	Bench-Scale Combustor Scheme 5-9A	65
63	Bench-Scale Combustor Scheme 5-10A	66
64	Bench-Scale Combustor Scheme 5-11A	66
65	Bench-Scale Combustor Scheme 5-12A	67
66	Variation in NO_x Concentration With Equivalence Ratio, Fuel Burned, and Inlet Air Temperature	67
67	Variation in NO_x Concentration With Equivalence Ratio and Inlet Air Temperature for Adulterated (0.5% Nitrogen) No. 2 Fuel Oil	68
68	Variation in NO_x Concentration With Equivalence Ratio and Inlet Air Temperature for Radial Fuel Injection at 50 psia Chamber Pressure	69
69	Bench-Scale Combustor Scheme 5-12B	70
70	Schematic Diagrams of Natural Gas Fuel Injection Means	70
71	Variation in NO_x Concentration With Equivalence Ratio Fuel Injection Means for Natural Gas/Air	71

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
72	Variation in NO_x Concentration With Equivalence Ratio and Fuel Injection Means for Natural Gas/Air	71
73	Bench-Scale Combustor Scheme 5-13A	72
74	Bench-Scale Combustor Scheme 5-14A	73
75	Bench-Scale Combustor Scheme 5-15A	73
76	Comparison of Variations in NO_x Concentration With Equivalence Ratio and Heat Exchanger Location for Natural Gas/Air (pc = 50 psia, Tair = 600°F)	74
77	Comparison of Variations in NO_x Concentration With Equivalance Ratio and Heat Exchanger Location for Natural Gas (pc = 50 psia, Tair = 800°F)	74
78	Comparison of Variations in NO_x Concentration With Equivalence Ratio With and Without Downstream Heat Removal (pc = 50 psia, Tair = 800°F)	75
79	Bench-Scale Combustor Scheme 5-16A	76
80	Bench-Scale Combustor Scheme 5-17A	76
81	Bench-Scale Combustor Scheme 5-18A	77
82	Bench-Scale Combustor Scheme 5-19A	77
83	Variation in NO_x Concentration With Equivalence Ratio, Type Fuel, and Rate of Heat-Removal for the Heat-Removal Concept (No. 5)	78
84	Comparison of Variation in NO_x Concentration With Equivalence Ratio and Chamber Pressure for Two Rates of Heat Removal in Concept No. 5 (Heat-Removal)	79
85	Bench-Scale Combustor Scheme 5-20A	80
86	Variation in Species Concentration With Equivalence Ratio for Concept No. 5 (Heat-Removal)	81
87	Bench-Scale Combustor Scheme 5-21A	82
88	Comparison of Variation in Emission Concentrations With Equivalence Ratio for Two Dilution Air Hole Shapes in Concept No. 5 (Heat-Removal) (Four Heat Exchange Modules, Downstream of Dilution Air Jets)	83
89	Bench-Scale Combustor Scheme 5-22A	84

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
90	Bench-Scale Combustor Scheme 5-23A	84
91	Bench-Scale Combustor Scheme 5-24A	85
92	Bench-Scale Combustor Scheme 5-25A	85
93	Variation in Species Concentration With Equivalence Ratio for Concept No. 5 — Heat Removal Using Air as the Coolant Fluid	86
94	Bench-Scale Combustor Scheme 5-26A	87
95	Bench-Scale Combustor Scheme 6-1A	88
96	Experimental Hardware Used in the Evaluation of Concept No. 6 — Quench Reheat	89
97	Bench-Scale Combustor Scheme 6-2A	90
98	Bench-Scale Combustor Scheme 6-3A	90
99	Bench-Scale Combustor Scheme 6-4A	91
100	Bench-Scale Combustor Scheme 6-5A	91
101	Variation in NO_x and CO Concentrations With Equivalence Ratio and Operating Mode for Quench-Reheat Combustor Concept (PC = 50 psia, T_{in} = 600°F)	92
102	Bench-Scale Combustor Scheme 7-1A	94
103	Bench-Scale Hardware Used in the Evaluation of Concept No. 7, Staged Centertube Combustor	95
104	Bench-Scale Combustor Scheme 7-2A	95
105	Bench-Scale Combustor Scheme 7-3A	96
106	Bench-Scale Combustor Scheme 7-4A	96
107	Bench-Scale Combustor Scheme 7-5A	97
108	Bench-Scale Combustor Scheme 7-6A	97
109	Bench-Scale Combustor Scheme 7-7A	98
110	Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner. a. Effect of Centertube Insertion Depth. b. Composite Plot of Data Items	99

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
111	Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner	100
112	Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner. a. Comparison of Ceramic and Metal Liners. b. Effect of Liner Pressure Loss (LPL)	101
113	Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner (Staging Effects). a. Scheme 7-2A (Centertube Insertion 2.0 in.). b. Scheme 7-3A (Centertube Insertion 2.0 in.)	102
114	Exhaust Gas Recirculation Module	106
115	EGR Combustor Scheme	106
116	Porous Plate Flameholders	107
117	Bench-Scale Combustor Scheme 11-1A	108
118	Experimental Hardware Used in the Evaluation of Concept No. 11 — Distributed Flame	108
119	Bench-Scale Combustor Scheme 11-2A	109
120	Bench-Scale Combustor Scheme 11-3A	110
121	Bench-Scale Combustor Scheme 11-4A	110
122	Bench-Scale Combustor Scheme 11-5A	111
123	Bench-Scale Combustor Scheme 11-6A	112
124	Bench-Scale Combustor Scheme 11-7A	112
125	Bench-Scale Combustor Scheme 11-8A	113
126	Bench-Scale Combustor Scheme 11-9A	113
127	Bench-Scale Combustor Scheme 11-10A	114
128	Comparison of Variation in Species Concentration With Equivalence Ratio for Two Flameholder Types in Concept No. 11 (Distributed Flame)	116
129	Bench-Scale Combustor Scheme 11-11A	117
130	Bench-Scale Combustor Scheme 11-12A	117
131	Ceramic Liner Mounting Scheme for Bench-Scale Testing	118

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
132	Boost-Air Dilution Combustor Module	121
133	Bench-Scale Combustor Scheme 14-1A	122
134	Bench-Scale Combustor Scheme 14-2A	122
135	Reductions in NO_x Achieved With Concept No. 14, Boost-Air Dilution	123
136	Experimental Hardware Used in the Evaluation of Concept No. 16 — Extended Injector	124
137	Bench-Scale Combustor Scheme 16-1A	125
138	Bench-Scale Combustor Scheme 16-2A	125
139	Bench-Scale Combustor Scheme 16-3A	126
140	Bench-Scale Combustor Scheme 18-1A	127
141	Air Staging Module Designed for Use in the Bench-Scale Combustor Program	129
142	Bench-Scale Combustor Scheme 26-1A	131
143	Bench-Scale Combustor Scheme 26-2A	131
144	Bench-Scale Combustor Scheme 26-3A	132
145	Experimental Hardware (Dilution Air Spraybar Module) Used in the Evaluation of Concept No. 28 — Rich Preburner	134
146	Bench-Scale Combustor Scheme 28-1A	135
147	Bench-Scale Combustor Scheme 28-2A	135
148	Variation in Species Concentration WithEquivalence Ratio for Concept No. 28 (Rich Preburner) With Dilution Air Spraybars	136
149	Bench-Scale Combustor Scheme 28-3A	137
150	Bench-Scale Combustor Scheme 28-4A	138
151	Bench-Scale Combustor Scheme 28-5A	138
152	Bench-Scale Combustor Scheme 28-6A	139
153	Bench-Scale Combustor Scheme 28-7A	139
154	Component Diagram of Rich Burning Concept	141

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
155	Bench-Scale Combustor Scheme 29-1A	141
156	Bench-Scale Combustor Scheme 29-2A	142
157	Bench-Scale Combustor Scheme 29-3A	142
158	Bench-Scale Combustor Scheme 29-4A	143
159	Bench-Scale Combustor Scheme 29-6A	143
160	Bench-Scale Combustor Scheme 29-7A	144
161	Bench-Scale Combustor Scheme 29-8A	144
162	Comparison of Characteristic NO_x Emission Signatures for Heat No. 2 Fuel and the Same Containing 0.5% Chemically-Bound Nitrogen	145
163	Typical Rich Burn/Quick Quench Arrangement	146
164	Typical Bench-Scale Rich Burn/Quick Quench Combustor Hardware	146
165	NO_x and CO Emission Signatures for the Rich Burn/Quick Quench Combustor Concept at Low Power Setting (0.5% Fuel Nitrogen, Scheme 29-8A)	147
166	Bench-Scale Combustor Scheme 29-9A	148
167	Bench-Scale Combustor Scheme 29-10A	148
168	Bench-Scale Combustor Scheme 29-11A	149
169	Bench-Scale Combustor Scheme 29-12A	149
170	Bench-Scale Combustor Scheme 29-13A	150
171	Bench-Scale Combustor Scheme 29-14A	150
172	Bench-Scale Combustor Scheme 29-15A	151
173	Bench-Scale Combustor Scheme 29-16A	151
174	Bench-Scale Combustor Scheme 29-17A	152
175	Bench-Scale Combustor Scheme 29-18A	152
176	NO_x and CO Emission Signatures for the Rich Burn/Quick Quench Combustor Concept at High Power Setting (0.5% Fuel Nitrogen, Scheme 29-9A)	153

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
177	NO_x Staging Capability	154
178	Effect of Primary Zone Airflow Staging on NO_x and CO Emissions (Scheme 29-19A)	155
179	Emissions from Simulated Engine Cycle	156
180	Bench-Scale Combustor Scheme 29-19A	158
181	Bench-Scale Combustor Scheme 29-20A	158
182	Bench-Scale Combustor Scheme 29-21A	159
183	Bench-Scale Combustor Scheme 29-22A	159
184	Bench-Scale Combustor Scheme 29-23A	160
185	Bench-Scale Combustor Scheme 29-24A	160
186	Bench-Scale Combustor Scheme 29-25A	161
187	Bench-Scale Combustor Scheme 29-26A	161
188	Bench-Scale Combustor Scheme 29-27A	162
189	Bench-Scale Combustor Scheme 29-28A	163
190	Bench-Scale Combustor Scheme 29-29A	164
191	Bench-Scale Combustor Scheme 29-30A	164
192	Bench-Scale Combustor Scheme 29-31A	165
193	Bench-Scale Combustor Scheme 29-32A	165
194	Bench-Scale Combustor Scheme 29-33A	166
195	Bench-Scale Combustor Scheme 29-34A	166
196	Bench-Scale Combustor Scheme 29-35A	167
197	Bench-Scale Combustor Scheme 29-36A	167
198	Bench-Scale Combustor Scheme 29-37A	168
199	Bench-Scale Combustor Scheme 29-38A	168
200	Bench-Scale Combustor Scheme 29-39A	169
201	Bench-Scale Combustor Scheme 29-40A	169

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
202	Bench-Scale Combustor Scheme 29-41A	170
203	Bench-Scale Combustor Scheme 29-42A	170
204	Bench-Scale Combustor Scheme 29-43A	171
205	Alternative Premixing Tube	171
206	Bench-Scale Combustor Scheme 29-44A	173
207	Bench-Scale Combustor Scheme 29-45A	173
208	Bench-Scale Combustor Scheme 29-46A	174
209	Bench-Scale Combustor Scheme 29-47A	174
210	Bench-Scale Combustor Scheme 29-48A	175
211	Bench-Scale Combustor Scheme 29-49A	175
212	Bench-Scale Combustor Scheme 29-50A	176
213	Bench-Scale Combustor Scheme 29-51A	176
214	Bench-Scale Combustor Scheme 29-52A	177
215	Bench-Scale Combustor Scheme 29-53A	177
216	Bench-Scale Combustor Scheme 29-54A	178
217	Bench-Scale Combustor Scheme 29-55A	178
218	Bench-Scale Combustor Scheme 29-56A	179
219	Bench-Scale Combustor Scheme 29-57A	179
220	Bench-Scale Combustor Scheme 29-58A	180
221	Bench-Scale Combustor Scheme 29-59A	180
222	Bench-Scale Combustor Scheme 29-60A	181
223	Bench-Scale Combustor Scheme 29-61A	181
224	Bench-Scale Combustor Scheme 29-62A	182
225	Bench-Scale Combustor Scheme 29-63A	182

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
226	Bench-Scale Combustor Scheme 29-64A	183
227	Bench-Scale Combustor Scheme 29-65A	183
228	Bench-Scale Combustor Scheme 29-66A	184
229	Bench-Scale Combustor Scheme 29-67A	184
230	Minimum NO_x as a Function of Primary Zone Residence Time	185
231	Bench-Scale Combustor Scheme 29-68A	186
232	Bench-Scale Combustor Scheme 29-69A	186
233	Bench-Scale Combustor Scheme 29-70A	187
234	Bench-Scale Combustor Scheme 29-71A	187
235	Bench-Scale Combustor Scheme 29-72A	188
236	Bench-Scale Combustor Scheme 29-73A	188
237	Bench-Scale Combustor Scheme 29-74A	189
238	Bench-Scale Combustor Scheme 29-75A	189
239	Bench-Scale Combustor Scheme 29-76A	190
240	Bench-Scale Combustor Scheme 29-77A	190
241	Effects of Secondary Zone Residence Time and Equivalence Ratio on CO Emmissions	195
242	Variation in Emission Concentrations With Fuel-Air Ratio for Tests Conducted With low Btu Gaseous Fuel	196
243	Variation in Emission Concentrations With Fuel-Air Ratio for Tests Conducted With Low-Btu Gaseous Fuel	197
244	Location of Streamtubes for Analytical Simulation of Concept 7 — Staged Centertube Burner	198
245	Comparison of Predicted and Experimental Emission Data, Concept No. 7 — Staged Centertube Burner	199
246	Comparison of Predicted and Experimental Emission Data, Concept No. 29 — Rich Burn/Quick Quench	201

LIST OF ILLUSTRATIONS (Continued)

Figure		*Page*
B-1	Bench-Scale Combustor Scheme 1-4B	B-2
C-1	Photograph of Acurex/Aerotherm Catalytic Burner Hardware	C-2
C-2	Acurex/Aerotherm Catalytic Combustor (Scheme 2-1A/B)	C-3
C-3	P&WA Alternate Injection — Premix Scheme 26-3A	C-3
C-4	Conversion of Bound Nitrogen to NO_x as a Function of Pressure	C-6

LIST OF TABLES

Table		*Page*
I	List and Brief Description of Combustor Concepts	2
II	Utilization of Major Bench-Scale Combustor Component Pieces	21
III	Bench-Scale Combustor Rig Operating Conditions	24
IV	Low-Btu Gas Composition (Water-Free Basis)	28
V	Combustor Operating Conditions of a Typical 25 Megawatt Engine With Free Turbine	29
VI	Comparison of Burner Characteristics for Configurations Tested in the Evaluation of Concept No. 1 — Low Intensity Flame	35
VII	Configurations Tested in the Evaluation of Concept No. 11	111
VIII	Combustor Configurations Having Ceramic Liner Sections	119
IX	Concepts Incorporating Fuel Staging	129
A-1	Combustor Operator Parameter Data	A-4
A-2	Emission Concentration and Gas Analysis Parameter Data	A-39
A-3	Combustor Liner Temperature Data and Fuel Air Ratio Information	A-76
A-4	Special Parameters — Heat Exchanger Information	A-113
A-5	Special Parameters — Pressure Drop and Airflow Rate Data	A-116
A-6	Special Parameters — Low Btu Gas Temperature	A-118
A-7	Special Parameters — Cooling Scheme Data	A-119
A-8	Special Parameters — Aero/Thermal Flow Modeling Data	A-120
A-9	Special Parameters — Smoke Data	A-121
B-1	Low-Btu Gas Composition	B-1
C-1	Catalytic Burner Data (Flow Conditions)	C-4
C-2	Catalytic Burner Data (Emissions)	C-5
C-3	Catalytic Burner Data (Temperatures)	C-5

SUMMARY

This report describes an exploratory development program to identify, evaluate, and demonstrate dry techniques for significantly reducing production of NO_x from thermal and fuel-bound sources in burners of stationary gas turbine engines.

Initially, duty cycle analyses were conducted to identify current and projected dominant operating modes and requirements of stationary gas turbine engines. These analyses indicated that the propensity for the generation of NO_x in combustors of stationary gas turbine engines will increase significantly in the future as compression ratios and turbine inlet temperatures are increased to improve thermal efficiency and net plant heat rate. In ten years, uncontrolled thermal NO_x generation is predicted to double over today's levels; in 20 years, the factor is predicted to triple. These predictions are based on an assumption that current fuel characteristics will prevail into the future. Uncontrolled emissions should increase by an even greater factor if future fuels contain significant amounts of chemically bound nitrogen.

An extensive survey was made of candidate combustor design concepts and an analytical study was accomplished from which those concepts considered to have significant potential for reducing production of NO_x were identified. The initial compilation of 26 design concepts included many variations of basic strategies such as fuel-rich combustion, ultra lean combustion, heat removal, fuel prevaporization, and fuel-air premixing. An assessment of the NO_x-control effectiveness of each concept was made using a combustor streamtube computer code. The code employs a modular approach in the prediction of combustor emissions (NO_x, CO, and unburned hydrocarbons), with sub models for the internal flowfield, physical combustion processes (including droplet vaporization and droplet burning), hydrocarbon thermochemistry, and NO_x kinetics. The initial analytical work is described in detail in Volume I of this report. While these analytical efforts were considered to be a valuable tool in the analysis of concepts, the results were used for guidance only, and were not considered conclusive evidence of concept potential.

In the work described in this volume, results of the computer studies as well as the general conclusions from the survey were drawn upon to select a group of concepts for experimental screening in a bench-scale combustor test rig. An erector-set approach was followed in the experimental program, making possible the rapid evaluation of many different concepts and combinations of concepts. About half the NO_x reduction techniques evaluated were based on fuel-lean burning, and half were based on fuel-rich burning. Two successful approaches were ultimately identified, and their performance relative to the program goals was assessed. It was concluded that one of the two concepts, referred to by the descriptive name "Rich Burn/Quick Quench," showed significant potential for application in stationary gas turbine engines, and was capable of meeting or exceeding all program exhaust emission goals.

Based on this assessment, the Rich Burn/Quick Quench concept was selected for implementation into the design of a full-scale (25 megawatt engine size) gas turbine combustor. In support of the design activity, additional bench scale tests were conducted to generate parametric data, and characterize the basic concept more fully. The final design and experimental evaluation of the full-scale combustor were carried out in subsequent phases of the program, described in Volume III and Volume IV of this report.

Appendix D gives SI unit conversions.

SECTION I

INTRODUCTION

Gas turbine engines used by the electrical utilities and by industry account for a relatively small portion of the total quantity of oxides of nitrogen (NO_x) emitted from stationary sources in this country. On a local scale, however, the gas turbine can be a significant contributor to air quality degradation, especially in the vicinity of engine installations where the NO_x background level is already objectionably high. In addition, the impact of stationary gas turbines may become more significant in the future. Along with the present modes of utilization, combined cycle and industrial cogeneration applications are being projected. The advanced engine technology needed to provide higher cycle efficiencies, and the anticipated firing of coal-derived, shale-derived, and petroleum residual fuels, will make it more difficult to meet proposed emission regulations.

Until recently, gas turbine combustors have been designed without regard for exhaust emissions. Initial attempts to control NO_x by modifying existing designs did not produce the targeted reductions. Although water injection was identified as an interim solution, this approach is not effective when nitrogen-laden fuels must be burned. In light of these developments, it was clear that new design concepts specifically addressing exhaust emissions should be considered.

Under EPA Contract 68-02-2136, an exploratory development program was undertaken to identify, evaluate, and demonstrate alternative combustor design concepts for significantly reducing the production of NO_x in stationary gas turbine engines. The investigations were directed toward dry combustion control techniques suitable for use in a 25 megawatt (nominal) engine. Operation on both petroleum distillate fuels (non-nitrogenous and nitrogen bound) and low-Btu gaseous fuels was specified. Program goals were 50 ppmv NO_x (at 15% O_2) for non-nitrogenous fuels (oil and gas), and 100 ppmv NO_x (at 15% O_2) for oil or gas containing 0.5% nitrogen by weight. The goal for CO was 100 ppmv (at 15% O_2). Accomplishment of the overall objective was effected via complementary analytical and experimental programs. Intrinsic in the support activities were combustor analytical model and engine duty cycle analyses, bench-scale screening tests of promising NO_x reduction concepts and, finally, full-scale evaluation tests of combustors incorporating the most promising NO_x reduction techniques.

The original program was accomplished in four phases. Phase I consisted of an analytical investigation of combustion concepts considered to have potential for reducing the production of NO_x. In Phase II of work, a number of promising low-NO_x concepts were bench-tested to select the best candidate for implementation into the design of a full-scale, 25 megawatt-size, utility gas turbine engine combustor. In Phase III, a full-scale low NO_x combustor was designed and fabricated. Verification testing of the prototype combustor was conducted in Phase IV, and guidelines regarding the applicability of the demonstrated low NO_x design technology to stationary gas turbine engines were generated.

SECTION II

DESIGN CONCEPTS

In Phase II bench-scale evaluation tests of candidate NO_x control concepts identified in Phase I were conducted. Data obtained during these tests were analyzed and used for two purposes: to rank the concepts in order of their potential for reducing NO_x, and to obtain the design information needed in Phase III to implement the most promising concepts into full-scale combustor hardware. The initial work in Phase II commenced with the design and procurement of rig hardware and with preliminary definition of the experiments required to evaluate the various concepts.

The following paragraphs present an overview of Phase I, primary concept selection, and concept descriptions detailing initial implementation to hardware leading into the experimental concept screening program which comprised Phase II and is described in Section III.

2.1 REVIEW OF PHASE I CONCEPT IDENTIFICATION

During Phase I of the program, an extensive review of the literature and of current design practices was conducted to identify combustion concepts with NO_x control potential. From this survey, a list of 26 (initially) candidate design concepts was compiled. This list of design concepts is presented in Table I, along with a brief description of each.

TABLE I. LIST AND BRIEF DESCRIPTION OF COMBUSTOR CONCEPTS

Concept No.	*Title and Description*
1	*Low-Intensity Flame* Extended length flame jet, fuel rich, mixes slowly with surrounding air. Bound nitrogen NO_x reduced under fuel rich conditions within flame jet.
2	*Premixing Catalytic Burner* Catalyst preceded by premixing/preburning module. In low power preburning mode, fuel is partially burned and mixed with air before entering catalyst, thereby ensuring uniform high temperature mixture for efficient operation of catalyst.
3	*Superlean With Heat Recirculation* Premix tube air preheated indirectly in liner convective cooling passages or by other means to improve fuel vaporization and widen flammability limits. Lean burning for low thermal NO_x.
4	*Superlean With Preburner* Premix tube air preheated directly by preburner to improve fuel vaporization and widen flammability limits. Lean burning for low thermal NO_x.
5	*Heat Removal* Coolant tubes inside the combustor reduce temperature of rich burning mixture before excess air is added for CO oxidation and final dilution.

TABLE I
LIST AND BRIEF DESCRIPTION OF COMBUSTOR CONCEPTS (Continued)

Concept No.	*Title and Description*
6	*Quench Reheat* Main burning zone is rich, resulting in low flame temperature. This mixture is rapidly quenched to a very lean equivalence ratio, causing excessive formation of CO but very little NO_x. In a reheat zone, effluent from a pilot burner heats the mixture to an intermediate temperature for CO consumption.
7	*Staged Centertube Burner* An axially staged burner configuration with swirl mixing. Concentric centertubes of different lengths determine the axial fuel-air distribution. As an experimental device the configuration allows easy variation of burning and mixing zone lengths. Both rich and lean air schedules were considered.
8	*Exhaust Gas Recirculation* Gas abstracted near the end of the primary zone, and mixed with fresh air in passages leading to the premix tube. Heat lost from the mixture in the passages (to surrounding inlet air) causes a reduction in flame temperature.
9	*Hydrogen Enrichment* Hydrogen injected along with fuel results in lower lean flammability limit of primary zone mixture.
10	*Surface Combustion* Flame stabilized in contact with surface of porous plate flameholder. Coolant tubes imbedded in plate remove heat from flame.
11	*Distributed Flame* Perforated plate flameholder produces many small flames, each stabilized separately, eliminating large scale recirculation and reducing residence times.
12	*Ceramic Liner* Wall quenching of flame diminished by the elimination of film cooling air and a higher allowable wall temperature.
13	*External Combustion* Combustor located outside the gas turbine engine. This concept essentially removes the geometrical and residence time considerations experienced with on-board combustors.

TABLE I
LIST AND BRIEF DESCRIPTION OF COMBUSTOR CONCEPTS (Continued)

Concept No.	*Title and Description*
14	*Boost-Air Dilution* Dilution air injected at higher pressure than other burner airflow to achieve higher mixing rate and reduce lag time in reaching desired equivalence ratios. Compressor or other means of achieving pressure differential required.
15	*Artificial Excitation* Vibrational excitation of burning gases in the combustor to increase reaction rates, allowing residence times to be reduced. Method of excitation may be acoustic, electronic, or other means.
16	*Extended Injector* Perforated plate flameholder with tubular extension pieces. By varying the number and length of tubes, their routing, and discharge points, mixture and temperature profile can be controlled.
17	*Pebble Bed* An external burning concept with a vertical discharge low velocity combustor. Ceramic (or other material) pebbles are fed in near the exit, fall through the flame, and remove heat. They are collected and recycled through a heat exchanger (where pebbles are cooled by inlet air) back into the combustor.
18	*Coanda Flame* Flameholder using coanda wall attachment effect. High velocity fuel-air mixture discharges through ring nozzle onto surface of concial nosepiece and entrains flow from surrounding environment. Method of setting up low intensity flame.
19	*Electric Assist Nozzles* Atomization of liquid fuel enhanced by an applied electric field, with dispersion of charged droplets which are further guided, vaporized and mixed with air under the influence of electric fields.
20	*Virtual Staging* Burning zone expands in volume and elongates as combustor loading increased (from idle to max. power). Flamefront grows into additional combustion airflow needed at max. power, thereby providing automatic or virtual staging.

TABLE I
LIST AND BRIEF DESCRIPTION OF COMBUSTOR CONCEPTS (Continued)

Concept No.	*Title and Description*
21	*Engine Inlet Fuel Injection* Vaporization and premixing of liquid fuel to very lean equivalence ratio for reaction in a catalyst or flameless combustor. Achieved by introducing fuel into engine inlet.
22	*Flameless Combustion* Large volume burner operating at very lean equivalence ratios. Consumes fuel by low-temperature long-residence-time flameless reactions.
23	*Air Staging* Combustor airflow distribution controlled by variable geometry to maintain desired equivalence ratios in burning zones and elsewhere over the range of engine operating points.
24	*Fuel Staging* Multiple fuel injection points provide variable fuel distribution and set up successive zones of desired equivalence ratios.
25	*Vorbix* Acronym — Vortex burning and mixing. Swirling air jets cause high rate of mixing in main burning zone. Pilot burner used for rapid vaporization of main fuel and controlled autoignition of resultant mixture. Lean burning for low NO_x.
26	*Fuel Air Premixing* Fuel injected into airstream prior to combustion zone to produce a uniform fuel-air mixture and reduce spread in localized equivalence ratios before burning begins.

Note: Concepts 27, 28, and 29 were conceived during the bench-scale evaluation program and are described in Sections 3.3.27, 3.3.28, and 3.3.29.

From this initial compilation of 26 concepts, twelve were subsequently selected for study using a combustor emission prediction computer code described in reference 1 and Volume I of this report. Parametric predictions were made showing the variation in emission characteristics with the principal design features of the various concepts. The general conclusions derived from the analytical modeling efforts can be summarized as follows:

1. To reduce the production of NO_x in the primary zone, rich burning, in the equivalence ratio range between 1.2 and 1.4 is preferred over superlean burning. Although the combustion process in the primary zone is incomplete as a result, the reaction can be directed to completion by carefully injecting and mixing dilution air.

2. Elevating the temperature of the primary-zone air supply to achieve more complete fuel vaporization is counterproductive under fuel-lean operating conditions, generally enhancing the production of NO_x.

3. The production of NO_x can be effectively curtailed by removing heat in the primary zone.

4. When rich burning is incorporated in the primary zone, dilution air must be rapidly injected and mixed to curtail further production of NO_x while also enhancing oxidation of carbon monoxide and unburned hydrocarbons. Mainstream temperature levels in the range from 2000 to 2800°F, for example, are most desirable.

5. Reducing NO_x production is enhanced by prevaporizing liquid fuel and mixing the fuel with air prior to entering the combustion chamber.

6. To curtail production of NO_x, recirculation-zone length should be minimized; a perforated-plate flameholder is a potential means for accomplishing this.

7. Significant reductions in NO_x production can be achieved by reducing or eliminating injection of cooling air into the main combustion stream; this is particularly true for the injection of air into the primary zone during fuel rich operation.

8. A promising means for reducing production of NO_x is to incorporate fuel staging in which the secondary fuel is uniformly distributed through

2.2 PRIMARY CONCEPT SELECTION

Five primary concepts were selected as exhibiting the greatest apparent potential for NO_x control on the basis of the information on hand at the end of Phase I. These concepts are defined and the basic reasons for their selection are explained below:

Concept No.	*Title*	*Reason for Selection As Initial Primary Concept*
1	Low-Intensity Flame	● Rich combustion for bound N ● Extended flame for radiant heat loss from flame jet ● Prevaporization of fuel ● Fuel premixing
3	Superlean with Heat Recirculation	● Lean combustion for thermal NO_x ● Heat removed from primary zone and recirculated to inlet for improved fuel vaporization ● Fuel premixing ● No cooling flow injected into primary zone
5	Heat Removal	● Rich combustion for bound N ● Removal of Heat in primary zone ● Fuel premixing and prevaporization ● No cooling flow injected into primary zone

6	Quench Reheat	● Rich combustion ● Rapid flame quenching ● Parallel lean combustor for reheating to consume CO ● Fuel premixing and prevaporization ● No cooling flow injected into combustion zones
7	Staged Centertube Burner	● Lean or rich combustion or combination of both ● Fuel premixing and prevaporization ● No cooling flow injected into combustion zones ● Swirl mixing for rapid buoyant interaction between zones ● Axial fuel-air ratio control ● Easy variation of configuration

These five concepts were only the initial selection of primary concepts and were subject to definitive testing described in section 2.4. It was entirely possible that other concepts not initially selected as primary could be moved to primary status based on exploratory testing.

The secondary concepts (those not designated as primary concepts) were selected from those of the remaining candidates that had apparent potential but required further substantiation. The secondary candidates fell into several categories. Some were complete design concepts, perceived to be self-sufficient approaches to NO_x reduction (Concept No. 8, Exhaust Gas Recirculation, is one example). Others were partial design concepts, often addressing a particular component and applicable only in combination with other concepts (Concept No. 14, Boost-Air Dilution for example, was considered for use in combination with rich-burning concepts such as Concept No. 6, Quench Reheat). Several of the secondary candidates were leading prospects for eventual evaluation as primary concepts. Others had been virtually eliminated from further consideration as a result of practical constraints or because they were judged to be outside the scope of the investigation (e.g., Concept No. 9, Hydrogen Enrichment was eventually dropped after the initial design study because of the practical requirement for an auxiliary source of hydrogen). Not every secondary concept was tested in the bench-scale program. Those with more apparent potential, and those that could be more readily implemented into bench-scale hardware were favored.

2.3 CONCEPT DESCRIPTIONS

Descriptions of the concepts evaluated in the bench-scale screening program are presented in this section. The major design criteria and the general method of implementation in experimental hardware of each of the first five primary concepts are discussed.

2.3.1 Concept No. 1 — Low-Intensity Flame

The low-intensity flame concept calls for fuel-rich burning under conditions of low-level turbulent mixing. Flame is stabilized as an elongated jet that originates at the fuel injector at the discharge plane of the premix tube, and extends well into the aft region of the combustor. Constituents within the flame interact slowly with the surrounding gases, and the central flame system remains at a high equivalence ratio for an extended period of time. Under these conditions, NO_x produced from both air and fuel-bound sources of nitrogen is diminished. As the jet mixes out, local values of equivalence ratio on the boundary of the jet decline and pass through unity, with a resultant increase in local mixture temperature. The propensity to form thermal NO_x under these conditions is offset by a loss of heat to the surroundings (by radiation) that has occurred along the length of the flame jet, and by partial vitiation of the surrounding gases from products of combustion that have previously mixed out.

The initial burner configuration selected to evaluate Concept No. 1 is shown in Figure 1. An aerodynamic swirler mounted in the dome of the combustor served as the principal flameholding device. The fuel-air mixture formed in the premixing passage (which accounted for approximately 12% of the total burner airflow) was accelerated in the throat (minimum area region) of the aerodynamic swirler and discharged at high velocity to produce a central flame jet inside the combustor. Additional airflow entering through tangential slots in the aerodynamic swirler (6.1% of total burner airflow) caused rotation of the gases on the periphery of the jet, and promoted mixing between the jet and its surroundings. The average mixture equivalence ratio was approximately 2.5, based on jet airflow alone, and 1.7, based on total aerodynamic swirler airflow. It was intended that an overall effective burning equivalence ratio of about 2.0 would be achieved by this arrangement.

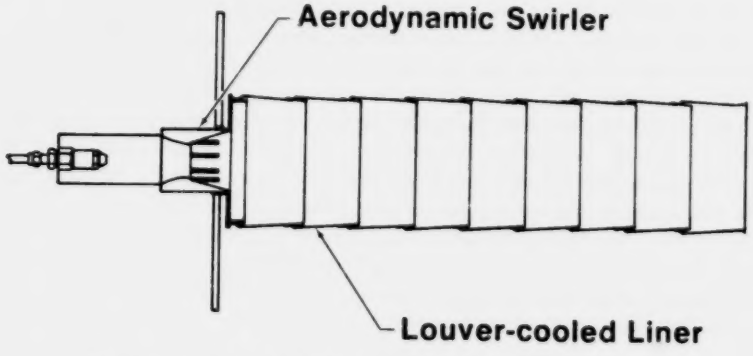


Figure 1. Initial Configuration for Concept No. 1

The combustor liner was louver cooled. All airflow (except aerodynamic swirler airflow) entered the combustor through cooling louvers. This arrangement provided gradual mixing of the flame jet with its surroundings. The length of the burner was 20 inch (L/D = 4), selected to allow ample distance for the flame jet to mix out.

2.3.2 Concept No. 3 — Superlean with Heat Recirculation

The principal feature of this concept is the provision for preheating premix-tube airflow to effect an improvement in fuel vaporization and to widen the flammability limits of the primary-zone fuel-air mixture. Airflow scheduled for the premix-tube is routed through convective-cooling passages within or around the burner and heated indirectly to a temperature several hundred degrees higher than the burner-inlet air temperature. In the primary zone, because of the increased heat content of the inlet air, the lean-blowout margin is improved. Thermal NO_x is reduced because of improved fuel vaporization and improved premixing, and because of the attainment of more uniform fuel lean equivalence ratios throughout the primary zone.

The bench-scale hardware utilized initally for Concept No. 3 is shown in Figure 2. A three-inch diameter premix tube was provided, through which approximately 61.8% of the total burner airflow was introduced. The resultant design point primary-zone equivalence ratio was 0.5 at an overall fuel-air ratio of 0.021. Premix-tube air was preheated to a temperature of about 1200°F in an array of tubes positioned in the combustor internal flow stream. Premix-tube mixture velocity was maintained at approximately 110 fps. A double-wall liner construction scheme was employed to provide convective cooling throughout the burner. Coolant airflow was discharged at the exit plane to prevent the occurrence of local over-lean regions within the burner.

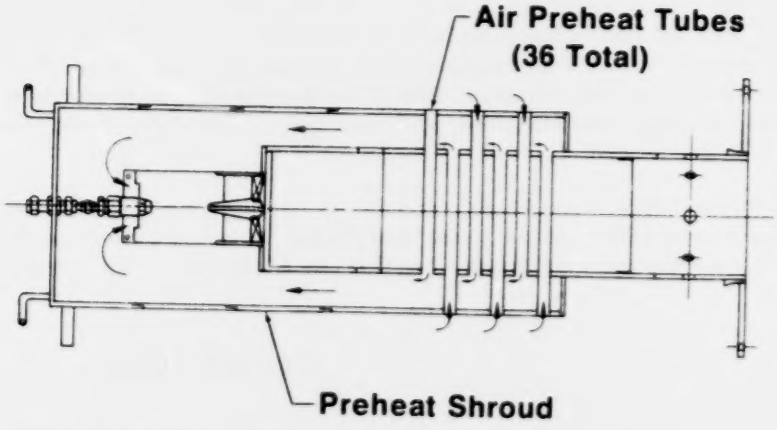


Figure 2. Initial Configuration for Concept No. 3

2.3.3 Concept No. 5 - Heat Removal

The heat removal concept involves rich burning and the subsequent removal of heat before the addition of the secondary air required to quench and dilute the primary-zone mixture to an overall lean exit-plane equivalence ratio. The principle design criteria for this concept were a primary zone equivalence ratio of 2.0 at the overall burner fuel-air ratio of 0.021, and the removal of a quantity of heat equivalent to a 400°F drop in burner inlet airflow temperature. To achieve these conditions, 15.4% of the total burner airflow was admitted through a two-inch diameter premixing tube (providing a mixture velocity in the tube of approximately 50 fps). Heat removal was effected in an array of quarter-inch diameter coolant tubes positioned approximately one diameter downstream from the dome.

Concept No. 5 was implemented in the basic bench-scale combustor in the manner shown in Figure 3. In initial tests, water was used as the coolant with flowrates adjusted to achieve the desired rate of heat removal. In subsequent tests, burner airflow was also adopted as a coolant. See Figure 4. Burner-liner cooling was accomplished convectively by means of the double wall construction indicated. This feature, which was common to several bench-scale burner configurations, allowed the effect of liner cooling airflow to be eliminated as an uncertain influence on emission results.

2.3.4 Concept No. 6 — Quench Reheat

This concept involves parallel burning stages: in one stage (the main burning zone) consumption of approximately two-thirds of the fuel supplied to the combustor takes place. In the other stage (pilot zone) the remaining fuel is burned to generate hot gases for later use. Rich burning is maintained in both stages. The mixture discharged from the main burning zone is abruptly quenched to a very lean equivalence ratio, producing a reduction in the average bulk temperature. Gases from the pilot zone are subsequently mixed in to achieve an average overall secondary zone temperature high enough for CO consumption but low enough to preclude thermal NO_x formation.

The bench-scale burner configuration selected for this concept is shown in Figure 5. A main burning zone was provided, sized to accommodate 8% of the total burner airflow. The resultant average equivalence ratio in the main burning zone was 2.26 (at FA = 0.021) corresponding to a flame temperature of approximately 2600°F. The pilot zone was supplied with 4.5% of the total airflow, resulting in the same burning conditions. A total of 54% of the total burner airflow was added in the quench zone, producing an equivalence ratio of 0.294 and a mixture temperature of approximately 2000°F. In the reheat zone, where the pilot zone and main burning zone flows were combined, an overall average (fuel lean) mixture temperature of 2600°F was the design point.

Convective cooling was employed in each of the burning zones. Coolant airflows from the main burning zone and from the pilot zone were discharged into the interior of the combustor, while coolant from the five-inch diameter section was discharged at the burner exit.

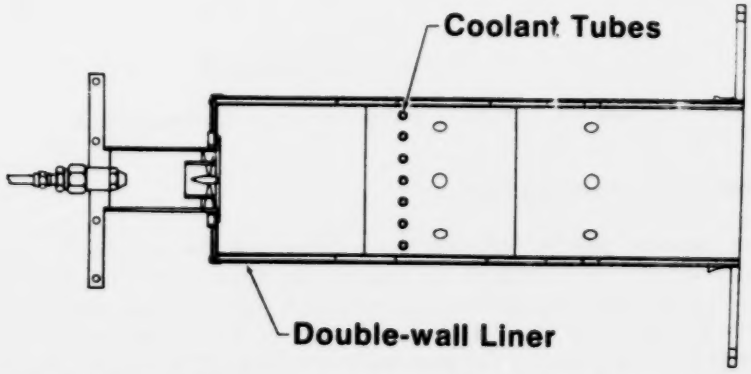


Figure 3. Initial Configuration for Concept No. 5 With Water as Coolant

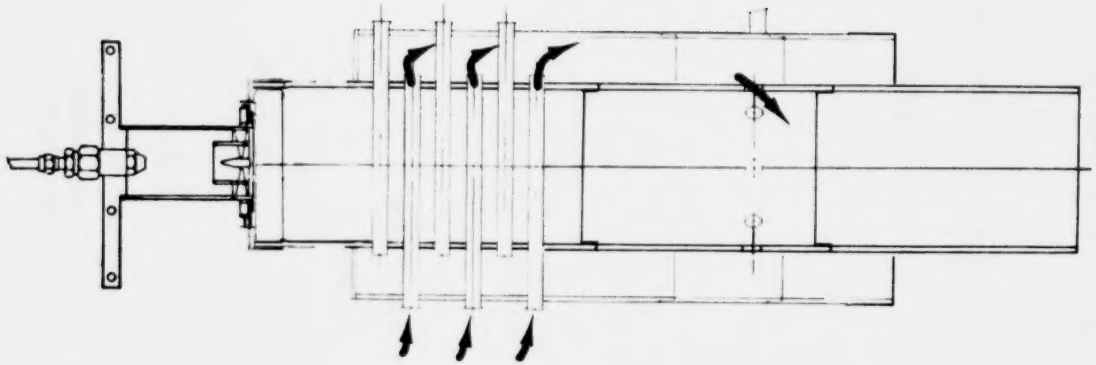


Figure 4. Configuration for Concept No. 5 With Air as Coolant

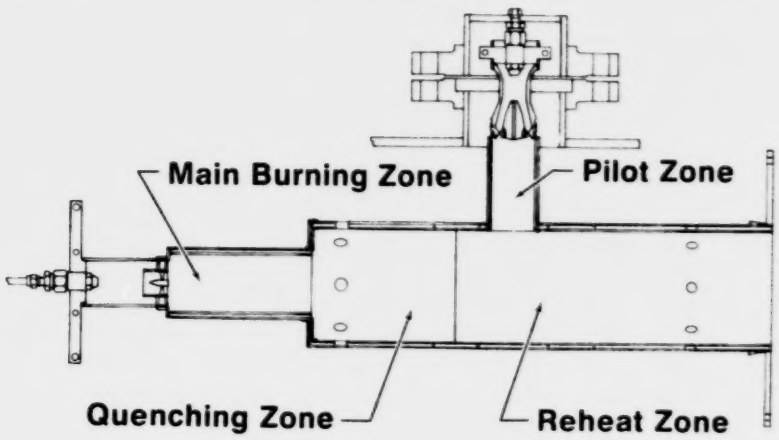


Figure 5. Initial Configuration for Concept No. 6

2.3.5 Concept No. 7 — Staged Centertube Burner

The staged centertube combustor incorporates swirl mixing and swirl burning as principal design concepts. Adoption of this basic combustor arrangement as a design concept in itself provided the opportunity to construct a versatile test piece to evaluate several major design concepts in combination with swirl mixing and swirl burning. As shown in Figure 6, the basic configuration consisted of a centertube structure with four concentric tubes, and a double-wall, convectively cooled liner. Each of the four tubes supplied air (or a fuel-air mixture) to a particular zone of the combustor. Swirl was imparted to the flow in each zone by vanes in the concentric tubes.

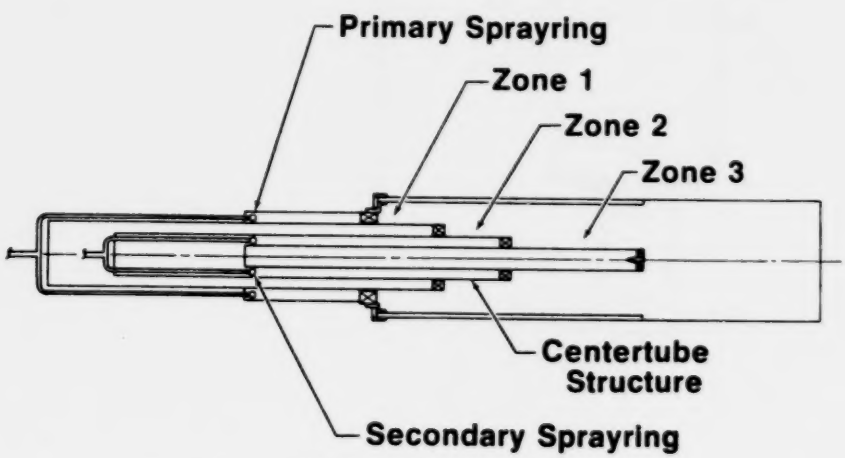


Figure 6. Initial Configuration for Concept No. 7

In the first zone, swirling flow provided the principal means of flame stabilization. Although no region of appreciable reverse flow was set up because of the centertube structure, the swirl vanes established a centrifugal force field that served to move the denser gases (cooler, unburned) radially outward, and the less dense gases (hot, burning) radially inward. The interactive movements of these gases caused an increase in turbulence and a higher turbulent flamespeed, making it possible to establish a stable flamefront with minimum dependence on regions of recirculating flow that may contribute to thermal NO_x formation.

In the second zone, dilution airflow was added through swirl vanes, again setting up a centrifugal force field. The dilution air (colder) entering this zone from the inner wall was forced radially outward, mixing rapidly with the burned gases from the first zone. This swirl mixing process was duplicated in the third and fourth zones where (colder) air and fuel-air mixture were introduced into the burned gases from the centertube.

The initial application of the staged centertube burner, involved lean burning and fuel staging, and was carried out according to the following scheme.

Zone 1 was used for idle operation. Twenty four percent of the total burner airflow was admitted through the outer concentric tube, resulting in an equivalence ratio of 0.6 at an overall fuel-air ratio of 0.010. This equivalence ratio was also maintained during operation at high overall fuel-air ratios.

Twelve percent of the total burner airflow was admitted to the second zone (no fuel added) resulting in an average equivalence ratio of 0.4 after mixing had been completed. The mixture temperature was approximately 2300°F (slightly higher or slightly lower depending on burner inlet air temperature). At this temperature, it was assumed that the rate of formation of thermal NO_x would be low, but that sufficient heat would be present for a strong piloting effect in the succeeding zone.

In the fourth zone, additional fuel and air were admitted to produce an equivalence ratio of 0.6 at an overall fuel-air ratio of 0.021 (at lower values of overall fuel-air ratio between 0.010 and 0.021, the equivalence ratio in the fourth zone varied between 0.4 and 0.6).

The airflow and fuel flow schedules cited above could be varied in the test program. The length of each zone could also be varied to determine the requisite stay time for the completion of burning and mixing processes, and for the termination of thermal NO_x formation.

SECTION III

EXPERIMENTAL PROGRAM

In Phase II, bench-scale screening tests of the design concepts selected in Phase I were conducted. Data obtained during these tests were analyzed and used for two purposes: first, to rank the concepts in order of their potential for reducing NO_x levels to those of the program goal and, second, to obtain design information needed in Phase III to implement the most promising concepts into full-scale combustor hardware. A continuing evaluation of the candidate design concepts described in Table I was carried out during the experimental study. In the course of the program, additional concepts were identified on the basis of the bench-scale test results.

This section addresses the Phase II experimental effort. It contains detail descriptions of the combustor and rig hardware, the test facilities and instrumentation, the basic test philosophy, the tests conducted, and the interpretation of test results. The heuristic nature of the test program is illustrated in the movement of the screening investigation from five initial concepts into a number of alternative approaches selected or synthesized on the basis of experimental results, to the final selection and characterization of a successful design concept.

3.1 TEST PHILOSOPHY

The purpose of the bench-scale test program was to determine experimentally the degree of NO_x control attainable with each of a number of candidate design concepts. It was desirable to evaluate as many different burner configurations as possible in order to select a successful concept (or more than one concept), and to generate data that might be required to substantiate the selection. Because of the exploratory nature of the program and the lack of prior knowledge of any particular concept that satisfied the established NO_x reduction goals, it was anticipated that an extensive amount of testing would be required. Under these circumstances, it was essential that the test program be conducted in a cost-effective manner so that all promising candidates could be screened, and a fair evaluation of each could be made.

The test plan was structured to reflect these considerations. An operating procedure was devised that allowed a large number of burner configurations to be tested, and permitted the amount of effort devoted to any one design concept to vary in accordance with the results obtained. Flexibility was considered paramount.

Experience in many previous burner development programs had taught that the number of cycles in a test program (each cycle consisting of a configuration change and subsequent testing) was often a determining factor in the degree of success ultimately achieved. The more successful programs had generally involved several major cycles of hardware development. In keeping with this experience, a provision was made for multiple cycles of hardware development in the evaluation of the many design concepts under consideration.

An overview of the test program is presented in Figure 7. The experimental effort was divided into five parts, consisting of: an initial period of component and system checkout; three cycles of testing; and a period of final refinement of the concept(s) chosen for implementation into full-scale combustor hardware. The initial checkout period was used to verify satisfactory operation of burner components and rig systems. Many of the design concepts tested in the course of the program made use of common burner-section and premixing-section modular component pieces (see Section 3.2.2). These components were subjected to preliminary development testing during the initial checkout period to correct unforeseen problems and to verify the intended performance. The proper functioning of all rig systems (such as the low-Btu-gas supply system, the ammonia injection system, and the high-pressure rig cases) was verified.

Initial • Component and System Checkout	Cycle 1 • Initial 5 Concepts • Preliminary Test Others	Cycle 2 • Retire 5 Concepts • Test Remainder	Cycle 3 • Retire 7 Concepts Concepts	Refinement • Final Concepts
Verify Basic Burner Components Checkout Rig Systems Low-Btu Gas System NH_3 Injection System	Primary Concepts - 1) Five from Initial Design Selection 2) Definitive Testing of These Concepts Secondary Concepts - 1) Preliminary Testing All Others Candidates - 1) Testing if Appropriate and Convenient Exploratory 1) Testing of New Leads and Ideas 2) Assign Status if Appropriate	Primary Concepts - 1) Select Additional Candidates 2) Retire Five Concepts Add Candidates for Exploratory Testing as Appropriate	Primary Concepts - 1) Select Additional Candidates 2) Retire Seven Concepts	Bench-Scale Refinement of Specific Configurations (Final Two Concepts)

Figure 7. Overview of Bench-Scale Screening Program Test Plan Outline

The logical structure of the test program is again illustrated in Figure 8. Experiments in Cycles 1, 2, and 3 were conducted according to several guidelines. First, candidate design concepts were divided into two groups: primary concepts, those that were judged to have significant promise and would be subjected to definitive testing; and secondary concepts, those that would be subjected to exploratory tests to determine whether further evaluation might be warranted. Typical screening cycles for primary and secondary concepts were conducted as shown in Figure 9. Initially, the primary group consisted of the five concepts selected in Phase I on the basis of analytical-model studies and information made available in the design compilation. In Cycle 1, definitive testing of these concepts was begun. This testing involved the evaluation of burner performance and emission characteristics at actual engine operating conditions, and at other select conditions selected to provide parametric results. The burner configuration was refined in each case, as appropriate, to ensure proper implementation of the design concept. The remaining concepts were placed, initially, in the secondary group to undergo exploratory testing in Cycle 1 as hardware and test time became available. Exploratory testing consisted of a brief evaluation of burner performance and emission characteristics at a few operating conditions selected to reveal salient features of the concept. Parametric data was not generated and no refinement of the hardware was attempted.

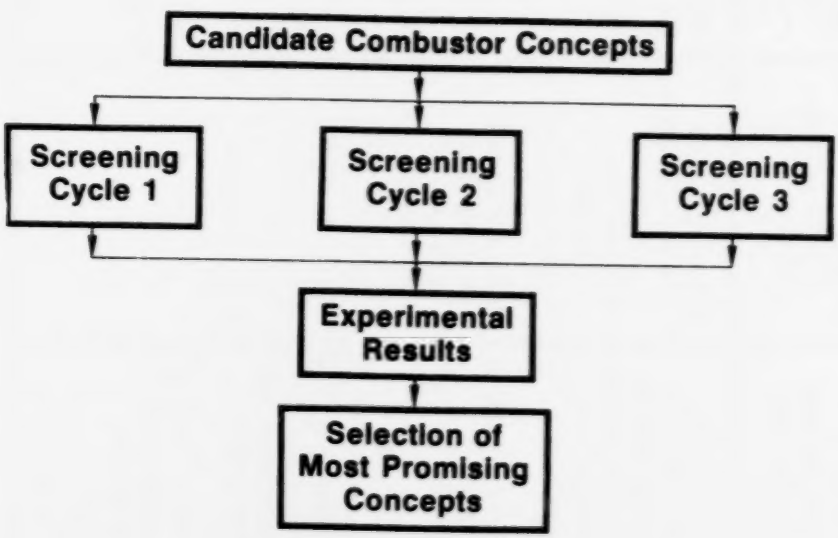


Figure 8. Phase II Bench-Scale Test Program

The two types of testing described (definitive and exploratory) were continued in Cycles 2 and 3. As the test program progressed, some of the more promising candidate concepts from the secondary group were transferred to the primary group for definitive testing. New candidate concepts were also added to the secondary group as they evolved from the various activities of the overall program. There was no limit placed on the number of candidates that might be included in the secondary group. It was considered desirable to test as many different concepts as possible, subject only to the overall program schedule and cost constraints. On the other hand, the relatively extensive testing required for primary concepts was costly and time consuming and, therefore, a limit of twelve was placed on the final number of concepts contained in the primary group.

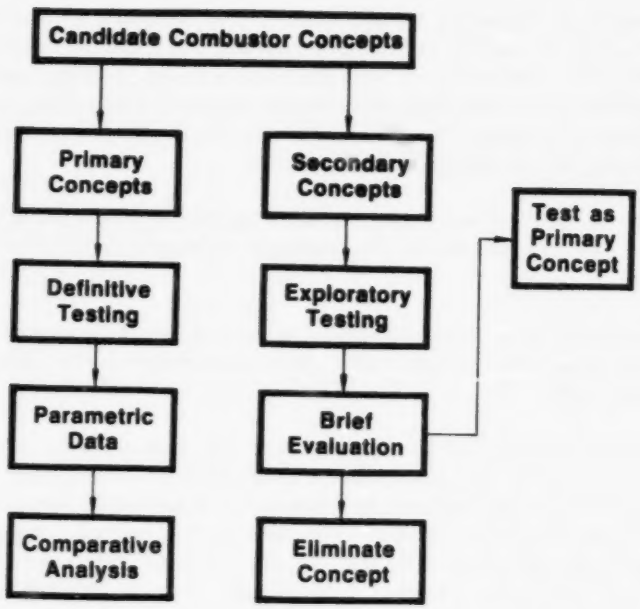


Figure 9. Typical Screening Cycle

The testing of primary candidate concepts took place according to an open-ended schedule. As discussed previously, it is not possible to determine *a priori* the number of burner configurational changes needed to properly implement a given design concept and render a fair evaluation. Accordingly, no fixed number of tests or test hours was specified for any concept. In order to ensure an orderly progression in the program however, it was required that definitive testing of five primary concepts be completed by the end of Test Cycle 2, and that definitive testing of the remaining seven be completed by the end of Test Cycle 3. The duration of testing for each concept, and the order in which the tests were completed, depended on the degree of difficulty encountered in each case.

At the end of Test Cycle 3, final refinement and parametric characterization of the concepts selected for Phase IV full-scale testing was undertaken. Emphasis was placed on scaling criteria, and the performance of full-scale burner components.

3.2 COMBUSTOR AND RIG HARDWARE

Careful consideration was given to the basic designs and methods of utilization of bench-scale burner hardware in Phase II. A major objective was to provide burner components having considerable versatility so that modifications to a particular configuration could be readily implemented on the test stand. To aid in achieving this goal, experimental parts were designed and fabricated to be interchangeable wherever possible, and were generally not restricted to use on any one concept. In addition, standardized burner and premixing-tube modules were adopted to help minimize the total number of parts that would be required. These pieces were pretested as separate components during the initial checkout period of the bench-scale program.

3.2.1 Basic Bench-Scale Combustor

In the bench-scale screening experiments, it was necessary to evaluate design concepts that would ultimately be applied in full-scale combustor hardware. In executing the design of the basic bench-scale combustor, it was desirable to reproduce as many of the essential features of a representative full-scale combustor as possible, and to take steps to minimize the inherent difficulties of scaling. These requirements led to the establishment of the following basic design criteria for the bench-scale combustor:

a. Size should be small enough to allow operation at actual engine pressures and temperatures within the available airflow capacity of the bench-scale facility.

b. Similarity to a representative engine combustor in space heat-release rate, reference velocity, and liner surface-to-volume ratio should be preserved.

Consideration of these criteria revealed that it was impossible to satisfy all the similarity constraints simultaneously. To illustrate, a combustor representative of full-scale design practice operated at a burner inlet-air flowrate of 33 lb_m/sec at a pressure of 211 psia and an inlet air temperature of 787°F. The available stand airflow capacity at the same pressure and temperature was approximately 3 lb_m/sec. If the full-scale combustor can be viewed as a cylinder (ten inch diameter, twenty inches long), then to achieve equivalent values of heat-release rate and reference velocity in reduced scale, a bench-scale combustor should be a cylinder approximately three inches in diameter and twenty inches long (one eleventh the volume and one eleventh the cross-sectional area). Unfortunately, a combustor of these dimensions would have nearly three times the surface-to-volume ratio of the full-scale can. Obviously the desired similarity in terms of surface-to-volume ratio cannot be maintained without relaxing one or both of the other two scaling criteria.

It was concluded that a compromise should be sought that combined reasonable values of the three scaling parameters and yet fell within the range of gas turbine combustor design experience. A baseline configuration calling for a combustor five inches in diameter and 15 inches long was proposed. These dimensions provided a space heat-release rate approximately 72% of that obtained in the referenced full-size can; the surface-to-volume ratio was greater by a factor of two; and the reference velocity was lower by a factor of three. Although the relative reduction in reference velocity was substantial it did not represent a radical departure from conventional design practice. Corresponding to an absolute value of approximately 50 fps, the reference velocity of the basic bench-scale configuration was very close to that of an operational combustor of comparable dimensions used in the PWA FT12 gas turbine engine. This close correspondence was viewed as an important assurance that potential difficulties of a fundamental nature (such as the existence of dimensions below the minimum quenching distance) would not be encountered in the bench-scale design.

The remaining differences between the proposed bench-scale configuration and the referenced full-scale burner did not appear to present insurmountable scaling difficulties. The bench-scale combustor had a slightly lower heat-release rate and a higher surface-to-volume ratio in addition to the lower reference velocity. It was not inconceivable that a successful design concept might be sensitive to these differences. If found to be important however, these differences could be resolved by revising the bench-scale design to achieve a configuration that reproduced the critical features of the full-scale combustor. A final refinement period of the bench-scale test program was reserved for this purpose. In the unlikely event that this transformation procedure might prove unsuccessful, a final alternative remained: to reproduce

the exact features of the bench-scale configuration in the full-scale design. Basically, a plurality of small combustors or a full-scale combustor with more surface area would be required. Such an approach could be taken at the expense of greater engine cross-sectional area and additional complexity. These changes do not represent insurmountable difficulties in stationary gas turbine engines applications.

3.2.2 Modular Hardware

The configurations illustrated in Figures 2 through 6 contained several modular pieces constructed in accordance with the philosophy outlined in 3.2.1. For example, the convectively-cooled dome piece in Figure 3 (Concept No. 5) is also common to Concept No. 6 (Figure 5), and to Concept No. 3 (Figure 2). In addition, five-inch diameter convectively-cooled burner sections were used interchangeably among Concepts 3, 5, 6 and 7. Two-inch diameter premixing-tube sections were used in common among Concepts 1, 5 and 6. Photographs of some of the "erector-set" hardware are presented in Figures 10 and 11. The interchangeability of the component parts is evident. Components were also made readily modifiable to facilitate changes and refinements in configuration during the experimental program. In Table II, a compilation of the major component pieces utilized for the various concepts is presented. Several different pieces were made available in each of several functional categories so that alternative designs could be drawn upon in fulfilling the various functional requirements of each burner configuration.

The method of assembling component pieces into complete burner configurations generally involved the use of standardized slip joints. Tubular sections were swaged or machined for insertion into mating sections having the same basic diameter. Entire stack-ups of premixing-tube and burner-section pieces were held in place by spacers secured to an "erector-set" framework and to the rear bulkhead plate of the rig (see Figure 12). The entire assembly was inserted into the bench-scale rig as shown in Figure 13.

3.2.3 Bench-Scale Rig

A schematic diagram and a photograph of the bench-scale rig used in Phase II are shown in Figures 14 and 15. The main rig components were the burner case, the exit duct, and the exit-plate assembly. These items were suspended from an overhead support structure by wheels that allowed axial movement of the entire assembly or of individual sections.

Burner test pieces were positioned inside the twelve-inch diameter burner case and mounted to a rear bulkhead plate that separated the burner compartment and the exit duct section. The test pieces extended upstream into the forward portion of the burner case where five access ports were provided for fuel lines, instrumentation, and quartz viewing windows. Burner exhaust was discharged into the water-cooled exit duct, where an additional side-mounted viewing port was provided. A viewing port in the exit plate was used to monitor the operation of the burner by video camera. Exhaust-emission probes were located in the exit duct and in the exit plate assembly. The exit-plate assembly was water jacketed and contained quench-water probes for cooling the back-pressure valve.

Figure 10. "Erector Set" Burner Hardware

Figure 11. Modular Burner Sections Used in the Bench-Scale Test Program

TABLE II. UTILIZATION OF MAJOR BENCH-SCALE COMBUSTOR COMPONENT PIECES

Component	*Diameter inches*	*Length inches*	*Concept* 1	2	3	4	5	6	7	8	10	11	12	14	16	18	23	25
Combustor Liners																		
Louver Cooled	5	20	•															
Ceramic	5	10											•					
Double Walled	5	Various			•	•	•	•	•	•	•	•			•			
Double Walled	2	4		•				•										
Double Walled	3	6							•									
Fuel Injectors																		
Central Nozzle	—	—	•	•	•	•	•	•		•	•	•	•		•			
Wall Injection	3	—				•												
Sprayring	2.4	—							•									
Premix Tubes																		
Cylindrical	1	2		•				•										
Cylindrical	2	4	•				•	•										
Cylindrical	3	Various			•	•				•			•		•	•		
Cylindrical	4	6										•						
Cylindrical	5	5									•							
Annular	2	Various							•									
Annular	3	Various																
Annular	4	Various							•									
Flameholders																		
Aerodynamic Swirler	2.5	—	•															
Conventional Swirler	1	—							•									
Conventional Swirler	1.5	—		•				•										
Conventional Swirler	2	—						•										
Conventional Swirler	3	—			•	•	•			•			•					
Swirl Vanes	4	—							•									
Swirl Vanes	3	—							•									
Swirl Vanes	2	—							•									
Porous Plate	5	—									•							
Perforated Plate	4	—										•						
Extended Injector	3	—													•			
Coanda	2	—														•		
Dilution Modules																		
Round Hole	5	Various	•	•	•	•	•	•	•	•	•		•					
Round Hole	3	4			•													
Slots	3	3	•															
Boost-air Dilution	5	4											•					
Vorbix	5	4																•
Variable Geometry	5	6														•		

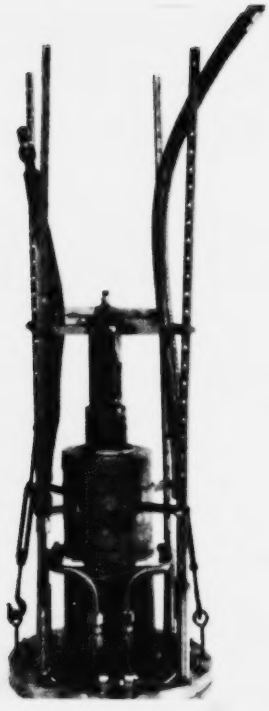


Figure 12. Bulkhead Plate and "Erector Set" Framework With Combustor

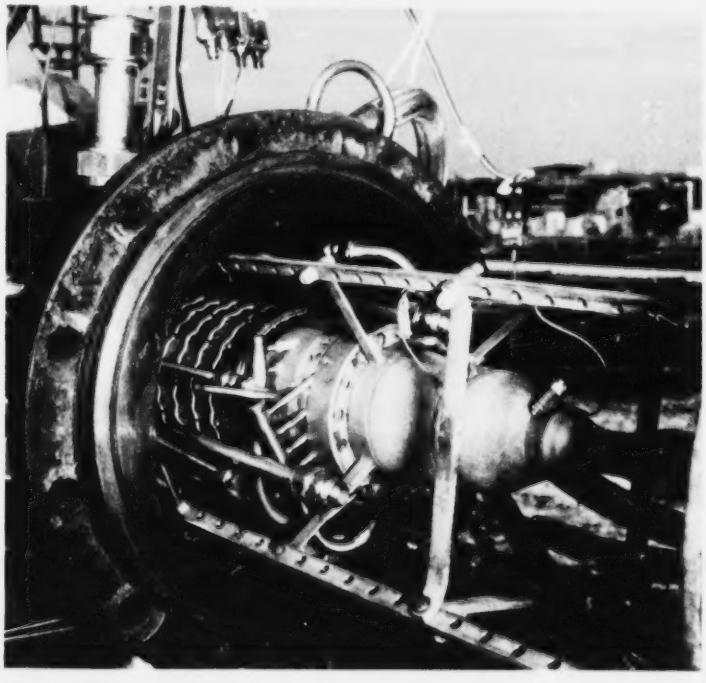


Figure 13. Bulkhead "Erector Set" Framework and Combustor Installed in Rig

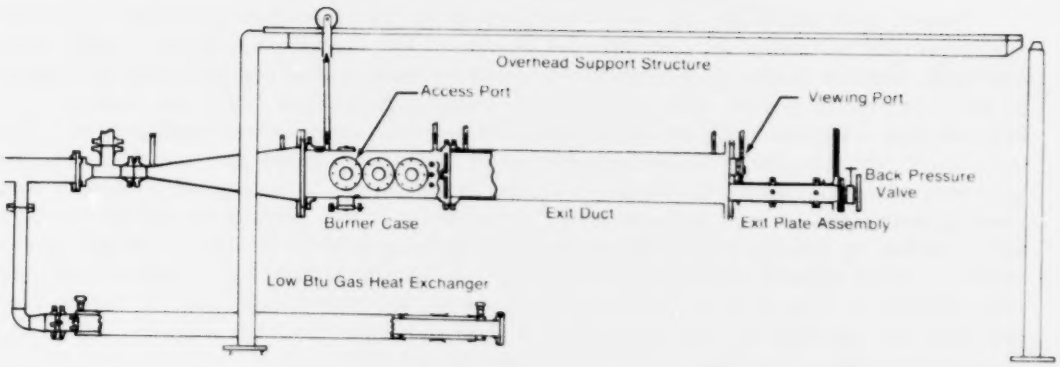


Figure 14. Schematic Diagram of Bench-Scale Rig

Figure 15. Photograph of the Bench-Scale Test Rig

Several features of the rig were incorporated in the interest of providing maximum configurational versatility for cost effective operation. For example, the rear-bulkhead plate was made movable so that burner test pieces could be positioned at any desired axial location in the burner case or exit duct. This feature made it possible to align any section of an experimental combustor with an access port. The quench-reheat burner configuration (Concept No. 6) took advantage of this arrangement by utilizing an access port to side mount the pilot-burner module shown in Figure 5. Other configurations were aligned to ensure that viewing ports could be used for monitoring the condition of key parts of the burner during a test. Another rig feature that provided configurational versatility was the overhead support structure, which allowed full access to all sides of the rig and facilitated the rapid removal and reinstallation of burner parts. A third feature was the interchangeability of access port hardware. Instrumentation, fuel lines, and quartz windows were built to a common design and could be mounted to any port in the burner case or exit duct.

3.2.4 Test Facilities and Instrumentation

The bench-scale program was conducted at a Pratt & Whitney Aircraft test facility used for engine hot-section components that utilize high temperature, high pressure air at modest flowrates. The combustor rig operating conditions are listed in Table III. Instrumentation was provided to measure burner operational parameters, including gas stream and metal temperatures, pressures, fuel flowrates, and airflow rates. A schematic diagram of the rig instrumentation system is shown in Figure 16.

Most tests were conducted by maintaining constant liner pressure loss at a constant inlet pressure and temperature. For a given pressure and temperature, constant liner pressure loss means nearly constant airflow (slight decline in airflow with increasing fuel-air ratio). Fuel flow was then varied to obtain an excursion in fuel-air ratio.

TABLE III. BENCH-SCALE COMBUSTOR RIG OPERATING CONDITIONS

Rig Airflow (max)	— 4 pps
Operating Pressure (max)	— 200 psia
Inlet Air Temperature (max)	— 1000°F
Fuel System	— Multiple zones for liquid fuel; single zone for low, medium, and high Btu gaseous fuels.
Ignition System	— TEB (pyrophoric) and spark ignition.

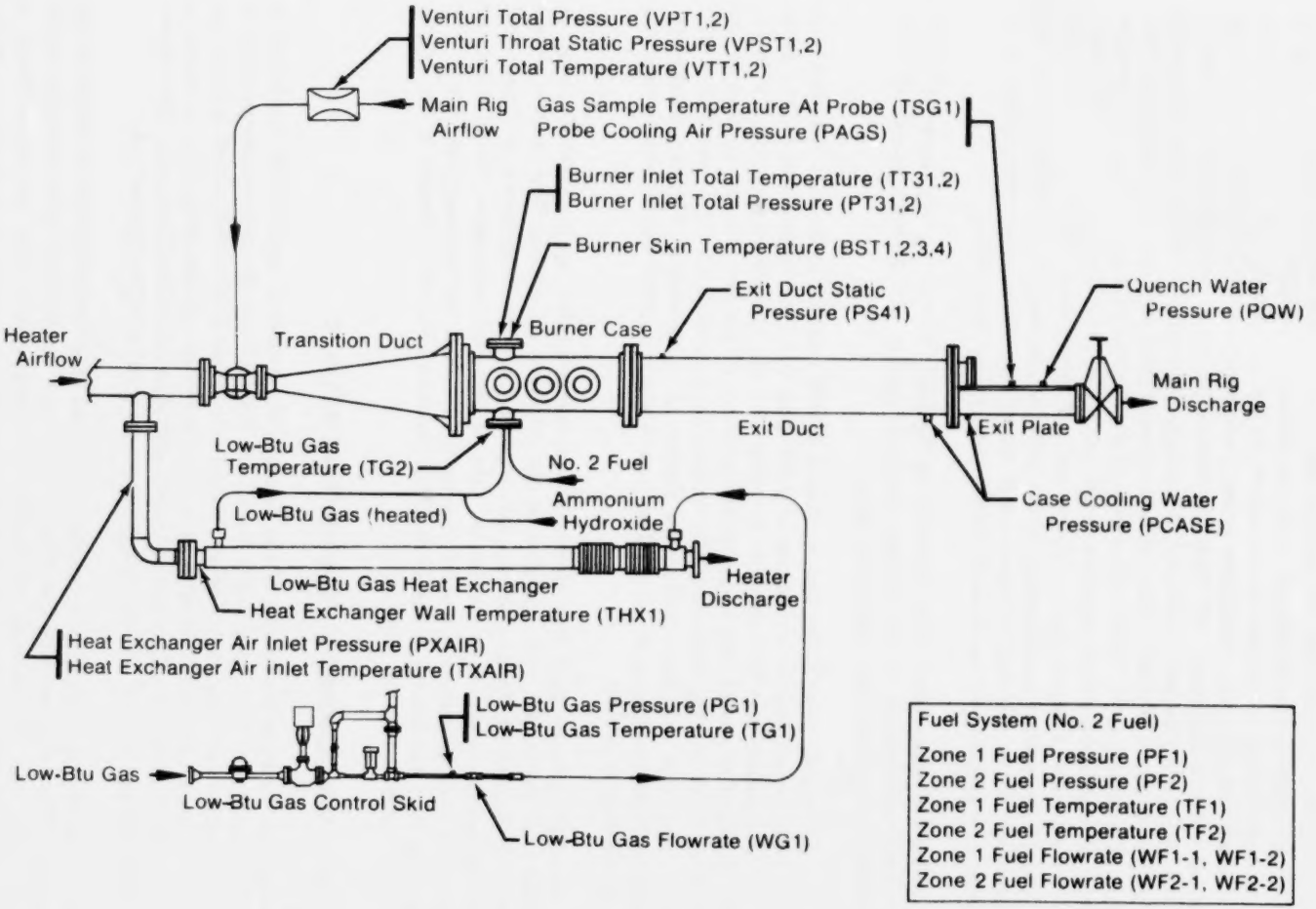


Figure 16. Schematic Diagram of Bench-Scale Rig (Instrumentation)

Analysis of gaseous emissions was accomplished with the equipment shown in Figure 17. A continuous sample flow of gas, abstracted from the burner exhaust, was conducted through an electrically heated transfer line to the gas-sample analysis system. Sample transfer time was maintained below two seconds. The gas sample was cooled in the sample probe to approximately 300°F, a temperature low enough to ensure quenching of high-temperature oxidation reactions, but high enough to prevent condensation. At the gas sample cart, instruments were provided for analyzing different constituent gases. Concentrations of unburned hydrocarbons were measured using a Beckman 402 Flame-Ionization Detector. Concentrations of carbon monoxide and carbon dioxide were measured by nondispersive-infrared Mine Safety Appliance Analyzers. Determinations of nitric oxide, nitrogen dioxide and ammonia concentrations were made using a Thermoelectron Chemiluminescent-Type Analyzer. A molybdenum converter, together with a high-temperature stainless steel converter, was used to adapt the latter instrument for ammonia analysis service. Filters and gas driers were also located within this system to ensure the proper conditioning of the exhaust-gas sample. All temperatures and pressures necessary for monitoring the operation of the gas-sampling system were measured by thermocouples and transducers maintained within the gas analysis cart.

The calibration gases used were traceable to National Bureau of Standards reference materials. Check calibrations of the testing standards against the primary standards were made periodically to ensure their continued accuracy.

Low-Btu gas was supplied to the test rig from a 51,000 standard cubic foot, roadable tube trailer. This trailer was filled to a pressure of 2,400 psig with the various constituent gases called for in the experimental fuel mixture. A typical dry gas analysis is shown in Table IV. Water with dissolved ammonia was added under pressure to the low-Btu gas mixture in the fuel line leading to the test rig. Reagent-grade ammonium hydroxide (28-32%) was mixed with the water to vary fuel nitrogen content. In Figure 18, a schematic diagram of the water/ammonia-addition equipment is shown. The system was fabricated from stainless steel and was inert to alkaline materials.

The low-Btu gaseous fuel was preheated to temperatures up to 1200°F using an indirect-fired heat exchanger that operated as an auxiliary rig system. The unit is shown schematically in Figure 18. Operation was accomplished by the introduction of liquid fuel through a fuel nozzle mounted in the center tube of the heat exchanger. Flame stabilized within the center tube by means of a small combustor provided the necessary heat input. The low-Btu gaseous fuel was heated to the desired temperature level while flowing in the reverse direction in an outer concentric passage.

3.3 BENCH-SCALE COMBUSTOR EXPERIMENTAL RESULTS

This section presents the results of the bench-scale screening experiments conducted in Phase II. Descriptions of the experiments have been divided into 29 groups corresponding to the 29 NO_x reduction concepts identified in Phase I and Phase II. Documentation in each case for which tests were conducted consists of a brief overview of the evaluation, a series of schematics of the hardware configurations tested, and selected exhaust emission data curves. Complete data listings for the bench-scale program are presented in Appendix A.

Table V shows the combustor operating conditions of a representative 25 megawatt gas turbine engine. This table contains the inlet pressure and temperature, the operating overall equivalence ratio, and the average combustor exit temperature over the entire range of conditions from cold start to peak load. It is included for comparing rig conditions to typical engine conditions.

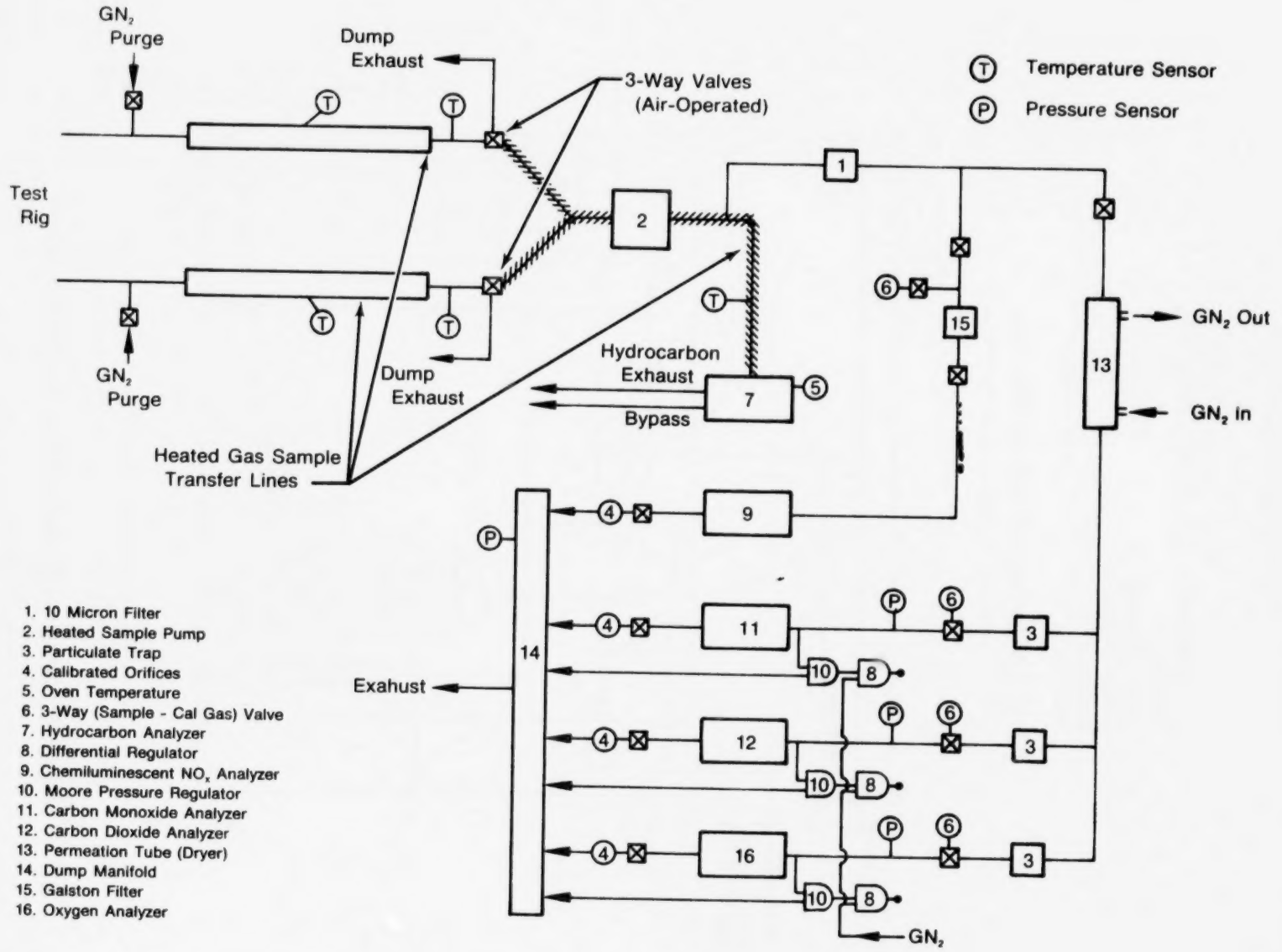


Figure 17. Schematic of Gas-Sample Analysis Equipment

TABLE IV. LOW-BTU GAS COMPOSITION (WATER-FREE BASIS)

Component	*Percent (volume)*
Methane	0.6
Carbon Dioxide	7.0
Carbon Monoxide	21.6
Hydrogen	13.3
Nitrogen	57.5

*Water and ammonia added in the line leading to the test rig.

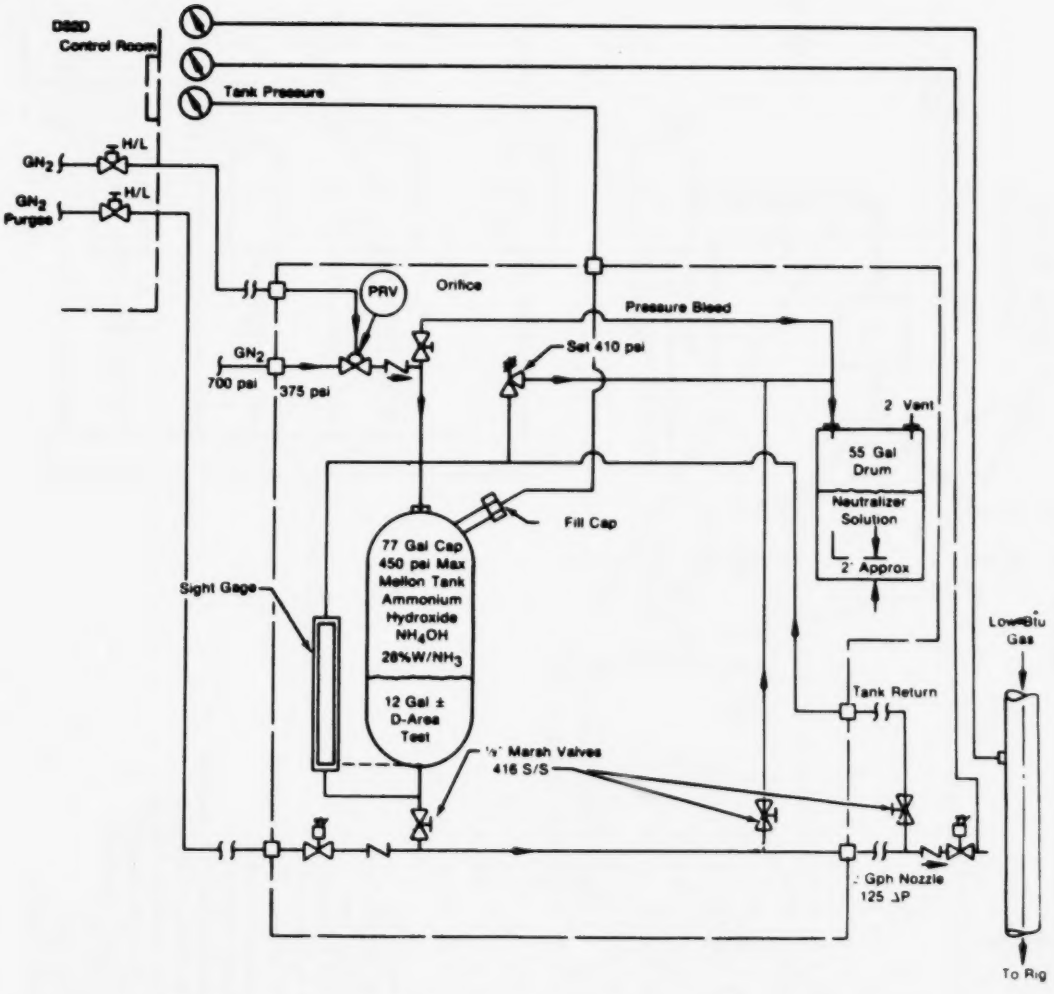


Figure 18. Schematic Diagram of Ammonia Addition System

TABLE V. COMBUSTOR OPERATING CONDITIONS OF A TYPICAL 25 MEGAWATT ENGINE WITH FREE TURBINE

Operating Point	*Inlet Total Pressure (psia)*	*Inlet Total Temperature (°F)*	*Exit Equivalence Ratio*	*Exit Temperature (°F)*
Peak Load	208	750	0.31	2100
Baseload (100%)	180	700	0.28	1950
70%	150	600	0.24	1650
50%	120	500	0.20	1450
Synch Idle	50	300	0.13	950
Cold Start	15	70	0.29	1450

The various combustor configurations tested were identified by a scheme number. The first number of the scheme identification is the concept number which corresponds to that listed in Table I. The number following the hyphen is the configuration (of the concept) number. The final alphabetic designation refers to minor modifications (for example, a fuel nozzle change) of the configuration not involving airflow distribution. For example, Scheme 29-15A would mean the fifteenth configuration of the Rich Burn/Quick Quench concept.

Scheme definition sheets are provided for all configurations tested. These include a scale drawing of the combustor and the following pertinent information:

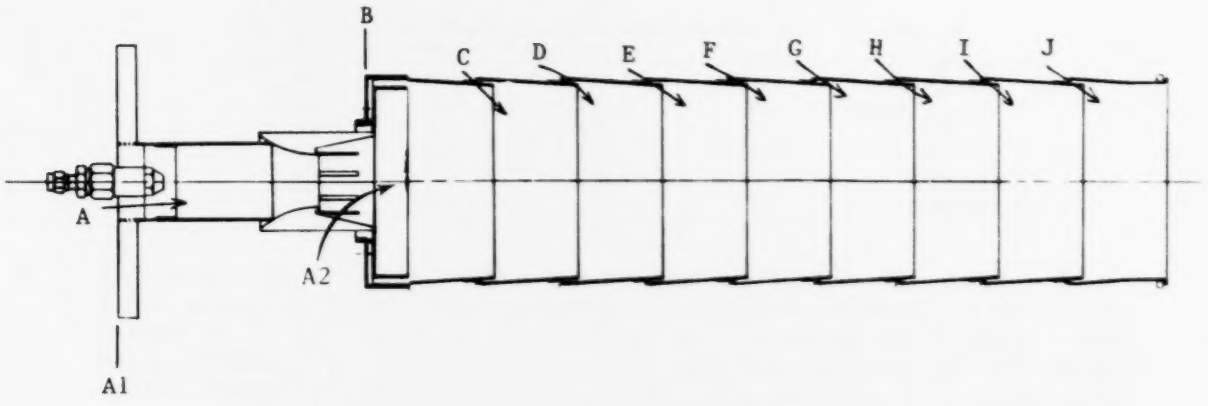
LB — Burner length
AREF — Reference area
L/D — Burner length to diameter ratio
VOLREF — Burner volume
ACDSUM — Total effective flow area including leakage
AX — Cross-sectional area at axial station identified
ACD — Effective flow area at indicated station.

Information pertaining to the evaluation and to the results obtained from each of the concepts are presented in the following 29 subsections in order of concept number. Actual testing of the concepts did not follow this order chronologically.

3.3.1 Evaluation of Concept No. 1 — Low Intensity Flame

The evaluation of Concept No. 1, Low Intensity Flame, was accomplished in two parts. First, several configurations of the bench-scale combustor (Schemes 1-1A, 1-2A, and 1-3A) were evaluated cursorily in conjunction with the initial checkout of rig hardware at the start of the program. Visual observations indicated generally unsatisfactory performance of all the initial configurations with regard to both premixing and flameholding functions. Exhaust emission characteristics were not fully documented in these tests. However NO_x concentration levels were generally observed to be high.

Scheme 1-1A. This initial configuration, defined in Figure 19, was identical to that described in Section 2.1.1. The experimental hardware is shown in Figure 20. Operation of the aerodynamic swirler proved unsatisfactory: the flame was non-uniform and polarized along a horizontal plane, apparently the result of non-axisymmetric feeding of air into the tangential slots of the swirler (plane A2 in Figure 19). The intended flame structure (elongated, fuel rich, as required under the Low Intensity Flame concept) was not achieved. The limited emission data obtained were characteristic of predominant diffusion burning (high NO_x levels, not strongly dependent on the overall burner fuel-air equivalence ratio) and weak flame stability (high CO and UHC, and a high lean blowout point).



LB	AREF	L/D	VOLREF	ACDSUM
27.00	21.24	5.19	424.7	2.53

STATION	AX	ACD
A	3.140	0.319
A1	3.140	0.0
A2	3.140	0.0
B	21.226	0.241
C	21.226	0.367
D	21.226	0.248
E	21.226	0.245
F	21.226	0.245
G	21.226	0.248
H	21.226	0.248
I	21.226	0.183
J	21.226	0.183

Figure 19. Bench-Scale Combustor Scheme 1-1A

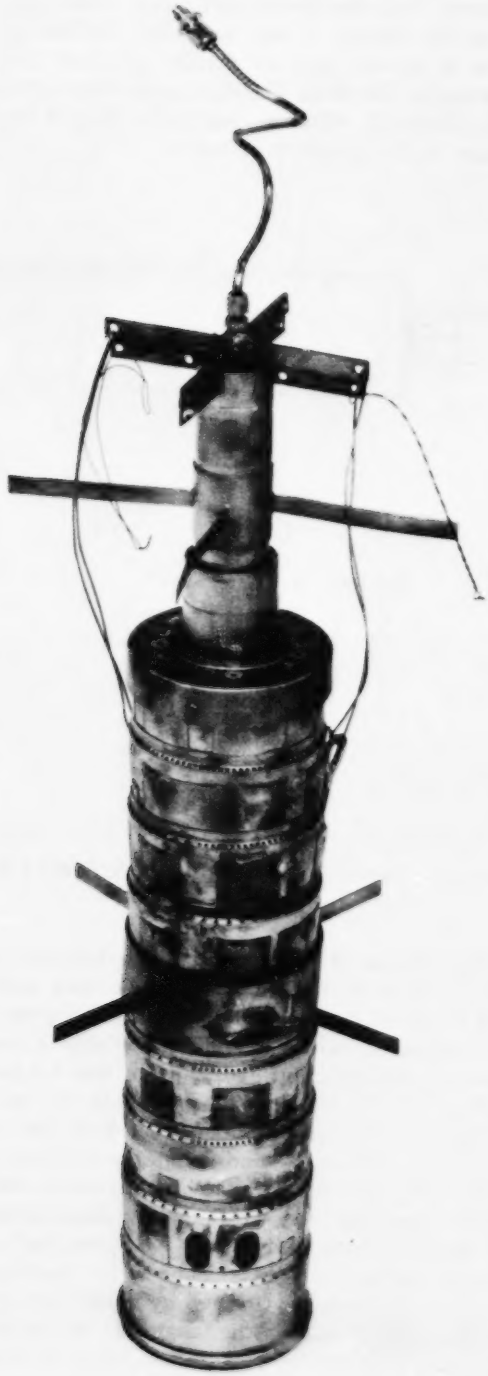
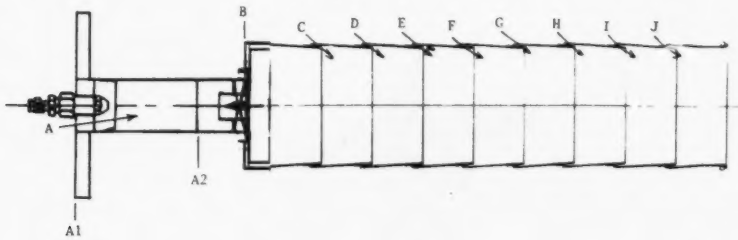


Figure 20. Experimental Hardware Used in the Evaluation of Concept No. 1 — Low Intensity Flame

Scheme 1-2A. Tests of this configuration (Figure 21) were conducted to establish baseline performance of the louver combustor using a standard axial swirler, and to verify that the non-axisymmetric flame previously observed had been associated solely with the aerodynamic swirler used in Scheme 1-1A. Results showed that a totally symmetric flame had been restored as a result of the swirler change. It was concluded that the aerodynamic swirler had been sensitive to distortions in the rig inlet air profile, and that other burner components (such as the fuel injector) were not involved. Baseline performance results were not obtained because of a fuel leak in the ductwork, which caused preignition of the fuel in the premixing passage and resultant damage to the premix tube swirler.



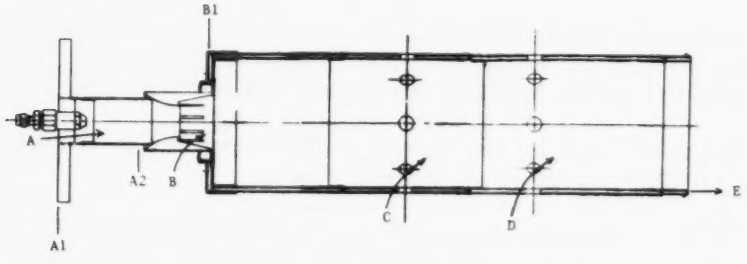
LB	AREF	L/D	VOLREF	ACDSUM
27.00	21.24	5.19	424.7	2.69

STATION	AX	ACD
A	1.331	0.319
A1	3.140	0.0
A2	3.140	0.162
B	21.226	0.241
C	21.226	0.367
D	21.226	0.248
E	21.226	0.245
F	21.226	0.245
G	21.226	0.248
H	21.226	0.248
I	21.226	0.183
J	21.226	0.183

Figure 21. Bench-Scale Combustor Scheme 1-2A

Scheme 1-3A. In this scheme (Figure 22) the aerodynamic swirler was retested in conjunction with a combustor liner having conventional burning zones (primary and secondary) set up by introducing penetration air (at sites C and D in Figure 22). The purpose of the test was to evaluate the aerodynamic swirler in conjunction with a combustor having no film cooling airflow (the double-wall construction employed in this scheme allows cooling air to pass along the entire length of the liner and be discharged at the exit plane). Comparison of the results to those obtained for Scheme 1-1A (which had film cooling airflow but no penetration airflow) were made to help isolate and define the effects of penetration airflow and louver cooling airflow on the flame established by the aerodynamic swirler. An investigation of flame structure and of interactions between the flame and liner airflow was also a principal objective. Results showed that the flame comprised a well-premixed core (which appeared as blue flame in the throat of the aerodynamic swirler at low fuel loadings), and an outer sheath in which diffusion burning was predominant (formed by liquid fuel on the wall of the premix tube, which had been entrained and burned in the tangential air jets at location B). Maximum liner heating occurred near the first row of penetration holes (location C in Figure 22), an indication that the flame jet produced by the aerodynamic swirler intersected the liner at that approximate location, and that additional heat release was occurring due to the introduction of penetration air jets. Carbon scales were formed on the wall of the combustor opposite each of

the first-row penetration jets, indicating that unburned fuel was still present in the combustor at location C. Flame stability was also noted to be poor, as in Scheme 1-1A. The flame jet was more symmetric than that observed for Scheme 1-1A, however the elongated structure intended was not achieved. The interpretation of these results was that the axial jet emanating from the center of the aerodynamic swirler had been weaker than intended and had not set up a strong dump recirculation zone. It had nevertheless served to spread flame along the axis of the burner. The tangential velocity component contributed by air introduced on the periphery of the jet (through the slots at B in Figures 20 and 22) served to generate turbulence but had not been great enough (by design) to produce strong flameholding. The presence of a substantial amount of liquid fuel in the tangentially-introduced airflow (at B) caused predominant diffusion burning. The net result was an overextended diffusion flame with poor stability characteristics and high NO_x.



LB	AREF	L/D	VOLREF	ACDSUM
27.50	19.09	5.58	305.4	2.87

STATION	AX	ACD
A	1.331	0.319
A1	2.924	0.0
A2	4.566	0.0
B	19.079	0.162
B1	19.079	0.0
C	19.079	0.974
D	19.079	1.178
E	19.079	0.241

Figure 22. Bench-Scale Combustor Scheme 1-3A

Conclusions drawn from these results were that: improvements in fuel-air premixing should be made to eliminate diffusion burning within the flame-tube and the presence of unburned fuel in the periphery of the flame jet; modifications should be made to the aerodynamic swirler to produce a more elongated flame jet (e.g. by an increase in jet velocity); and that penetration air should not be employed because of probable disruption of the flame jet.

Scheme 1-4B. This configuration, utilized for low-Btu gas firing, is described in Appendix B.

In the second part of the evaluation of Concept No. 1 (Low Intensity Flame), six additional bench-scale combustor schemes were examined. In the previous tests the aerodynamic swirler had been employed as a candidate long-flame generator. This device had been unsuccessful in that role, producing a diffuse, sometimes distorted flame that spread to the wall of the burner can. The limited emission data obtained had been generally characteristic of

predominant diffusion burning and weak flame stability. Not only were NO_x concentration levels high (an indication of extensive burning at near-stoichiometric conditions), but lean blowout had occurred at an unusually high burner overall fuel-air ratio (about 0.014, corresponding to about 50% power in a typical 25 m.w. gas turbine engine).

In considering what changes might be made to better achieve the long-flame burning characteristics desired, a review was made of the basic requirements and principles of the Low Intensity Flame Concept. These were summarized as follows:

1. An elongated, rich, flame should be established by introducing a high-velocity jet of premixed fuel and air along the axis of the burner.

2. The rate of mixing of the jet with the surrounding air should be controlled to preserve the integrity of the long flame.

3. Burning should take place within the jet at fuel-rich equivalence ratios; the resultant low flame temperature and lack of oxygen serve to inhibit the formation of NO_x from both thermal and fuel-bound sources.

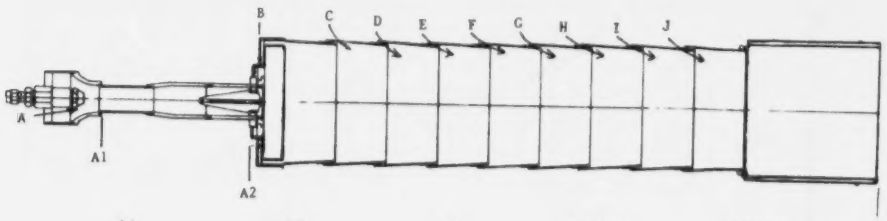
4. The flame must be long enough to allow time for completion of the relatively slow reactions of fuel-rich burning.

5. Flame stability is provided by diffusion burning on the boundary of the jet (where the fuel-rich mixture and the surrounding air diffuse into one another). This process must be limited in magnitude to avoid excessive thermal NO_x formation, but must be sufficient to "pilot" the rich flame.

6. Final mixing and burning of the products of rich combustion from within the jet must be spread out over a large area so that the average local flame temperature is reduced by radiative heat loss and by entrainment of previously evolved products of combustion.

A common denominator in the requirements listed were the establishment of a strong central flame jet, and careful control of the rate of mixing (and burning) of the jet with its surrounding environment. Subsequent modifications made to the combustor hardware were designed to strengthen the central flame jet (by increasing the axial velocity), and to investigate alternate methods of controlling the rate of mixing of the jet with air introduced through the combustor liner.

Scheme 1-5A. (Depicted in Figure 23) This scheme featured a four-fold increase in jet axial velocity, and the elimination of swirl (Table VI summarizes the salient features of this scheme, and others subsequently tested). A centerbody was mounted at the discharge plane of the premixing tube to serve as a bluff body flameholder for the central flame jet; this gave the jet an annular cross-section, at least initially. Complete exhaust emission data were obtained. The variation in NO_x concentration with the equivalence ratio for Scheme 1-5A is illustrated in Figure 24. Concentration levels were found to be high (compared to other rich-burning concepts, such as heat removal (described in Section 3.3.5), and were found to decline as the overall equivalence ratio was increased. Visual observations of the flame, as recorded on video tape, showed the presence of a distinct flame jet only at very low equivalence ratios. These results, taken together, indicated that some burning had occurred under locally fuel-rich conditions (as evidenced by the decline in NO_x at higher equivalence ratios), but that diffusion burning had also occurred, causing generally high NO_x concentration levels. The latter observation was supported by the lack of a distinct flame jet.



LB	AREF	L/D	VOLREF	ACDSUM
23.25	19.63	6.65	490.6	4.73

STATION	AX	ACD
A	2.924	0.404
A1	0.828	0.0
A2	0.945	0.0
B	19.079	1.247
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.246
I	19.625	0.183
J	19.625	0.183
X	113.040	1.117

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	6.00	6.66	0.0
BST2	10.00	2.50	0.0
BST3	16.00	2.50	0.0
BST0	0.0	0.0	0.0

Figure 23. Bench-Scale Combustor Scheme 1-5A

TABLE VI COMPARISON OF BURNER CHARACTERISTICS FOR CONFIGURATIONS TESTED IN THE EVALUATION OF CONCEPT NO. 1 — LOW INTENSITY FLAME

Scheme	ϕ_p [1]	ϕ_{jet} [2]	V_{jet} [3]	D_{jet}/D_{can} [4]	*Firing* Swirl No.	Rate[5]
1-1A	2.2	1.8	75	0.26	0.8	$1.3*10^6$
1-5A	0.9	3.6	330	0.14	0	$1.5*10^6$
1-6A	2.1	3.4	330	0.14	0	$1.5*10^6$
1-7A	1.4	1.9	330	0.20	0	$1.3*10^6$
1-8A	0.75	1.3	390	0.23	0.4	$1.6*10^6$
1-9A	0.8	2.6	390	0.17	0.2	$1.5*10^6$
1-10A	0.9	4.1	390	0.14	0	$1.4*10^6$
18-1A[6]	1.4	3.4	330	0.14	0	$1.1*10^6$

NOTES:
[1] Average primary zone equivalence ratio
[2] Average jet equivalence ratio
[3] Jet velocity in ft/sec
[4] Ratio of jet to can diameter
[5] Btu/hr/atm/ft^3
[6] This scheme is essentially the same concept — Low Intensity Flame — except a secondary concept (No. 18) — Coanda Flame was employed as the means of flame stabilization.

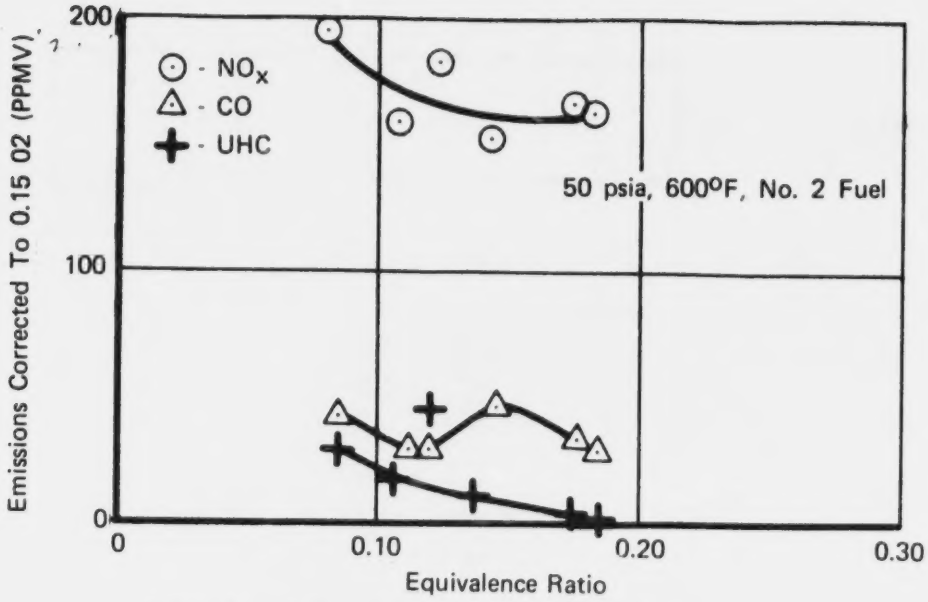
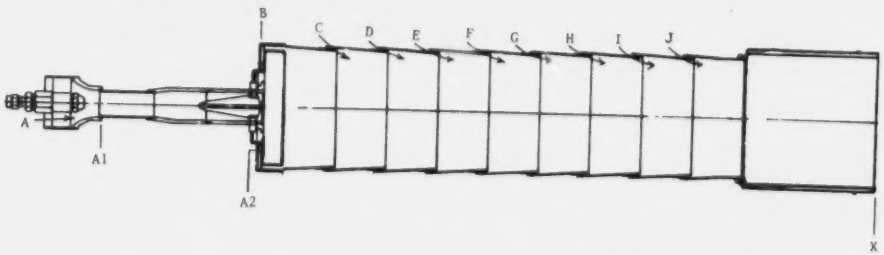


Figure 24. Exhaust Emission Data for Scheme 1-5A

Scheme 1-6A. This scheme was identical to Scheme 1-5A except for a reduction in dome cooling airflow (see Figure 25). This modification, which resulted in a higher average primary zone equivalence ratio in Scheme 1-6A, was made in order to determine whether the diffusion burning encountered in Scheme 1-5A had been caused in part by excessive primary zone film cooling airflow. A comparison of NO_x data for these two schemes (Figure 26 and Figure 24) showed no appreciable difference.



LE	AREF	L/D	VOLREF	ACDSUM
33.25	19.63	0.65	490.8	4.46

STATION	AX	ACS
A	2.924	0.404
A1	0.648	0.0
A2	0.945	0.0
B	19.079	0.295
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.246
H	19.625	0.246
I	19.625	0.183
J	19.625	0.183
X	113.040	1.834

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST4	6.00	6.66	0.0
EST2	10.00	2.50	0.0
EST3	16.00	2.50	0.0

Figure 25. Bench-Scale Combustor Scheme 1-6A

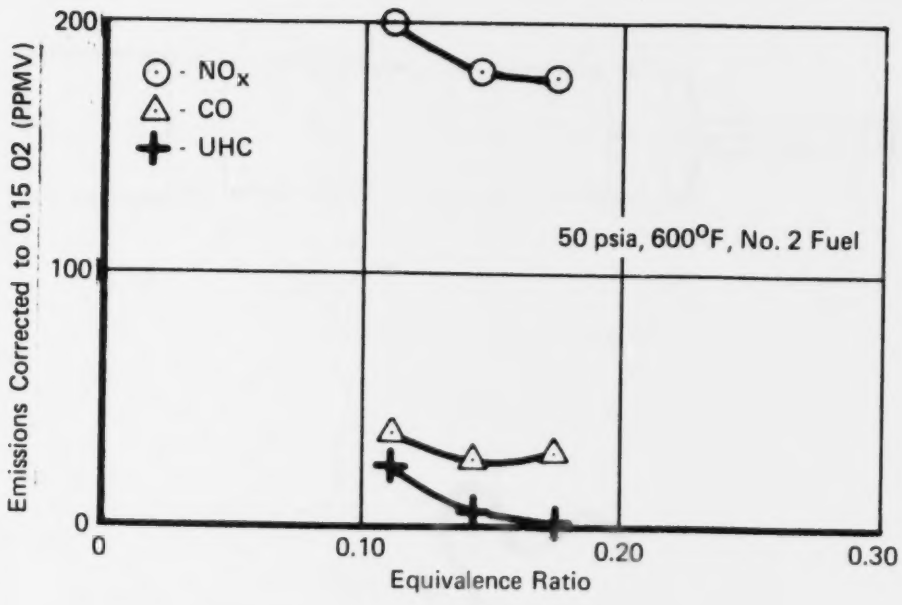


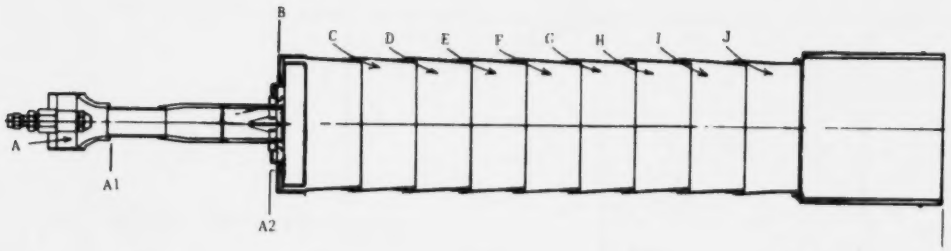
Figure 26. Exhaust Emission Data for Scheme 1-6A

Scheme 1-7A. Scheme 1-7A differed from Scheme 1-6A in only one respect: the centerbody at the discharge plane of the premix tube was replaced by one of smaller diameter (0.5 in. dia vs 0.8 dia). This change resulted in a slightly higher premix tube airflow rate (the centerbody having been the restricting area in that passage), and also brought about a lower average primary zone equivalence ratio. (See Figure 27 and Table VI).

NO_x concentration data for Scheme 1-7A using neat No. 2 fuel oil are illustrated in Figure 28. The nearly horizontal appearance of the curve was interpreted as evidence of a diffusion-burning process that is essentially invariant with overall equivalence ratio.

Data for Scheme 1-7A were also measured at two values of liner pressure loss (LPL) other than the nominal value of 3%. Changes in airflow were used as the means of varying LPL; thus not only LPL, but burner reference velocity and the absolute levels of fuel flow and airflow were varied. Isolated NO_x data points for LPL = 1% and LPL = 6% appear in Figure 28. For both these values of LPL, NO_x concentrations were lower than for LPL = 3%.

Tests were also conducted with Scheme 1-7A using No. 2 fuel with 0.5% bound nitrogen (pyridine additive). These data are presented in Figure 29. The variation in NO_x concentration and the variation in nitrogen conversion with equivalence ratio are shown for tests conducted at 3% liner pressure loss. As expected, the rate of conversion was higher at the lower equivalence ratios, and declined to a value of about 20% under the locally rich burning conditions associated with the higher overall equivalence ratios.



LB	AREF	L/D	VOLREF	ACUSUM
33.25	19.63	6.65	490.8	4.76

STATION	AX	ACD
A	2.924	0.749
A1	0.828	0.0
A2	0.965	0.0
B	19.079	0.255
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.248
I	19.625	0.183
J	19.625	0.182
X	113.040	1.785

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	6.00	0.66	0.0
BST2	10.00	2.50	0.0
BST3	16.00	2.50	0.0

Figure 27. Bench-Scale Combustor Scheme 1-7A

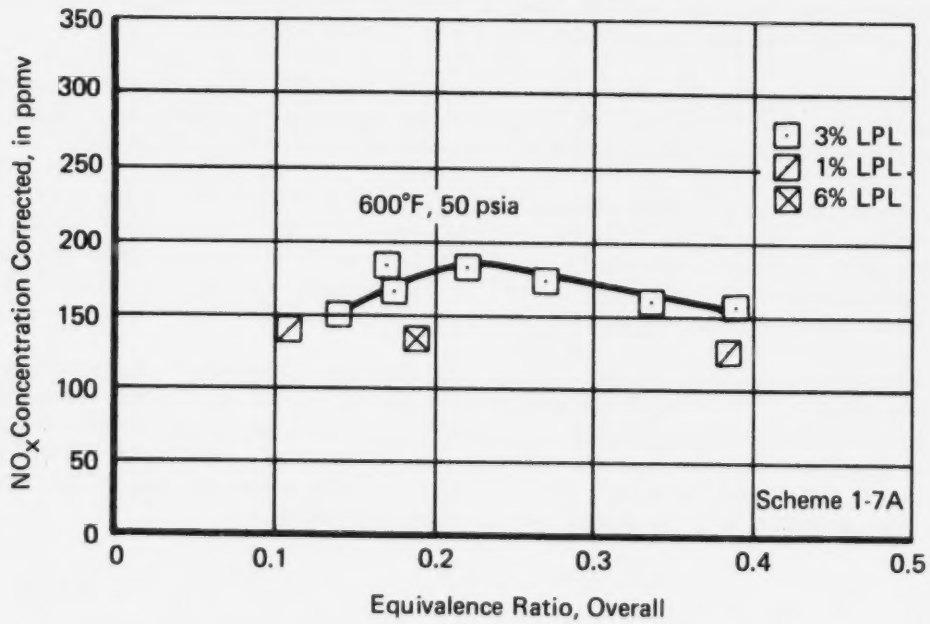


Figure 28. Exhaust Emission Data for Scheme 1-7A (No. 2 Fuel)

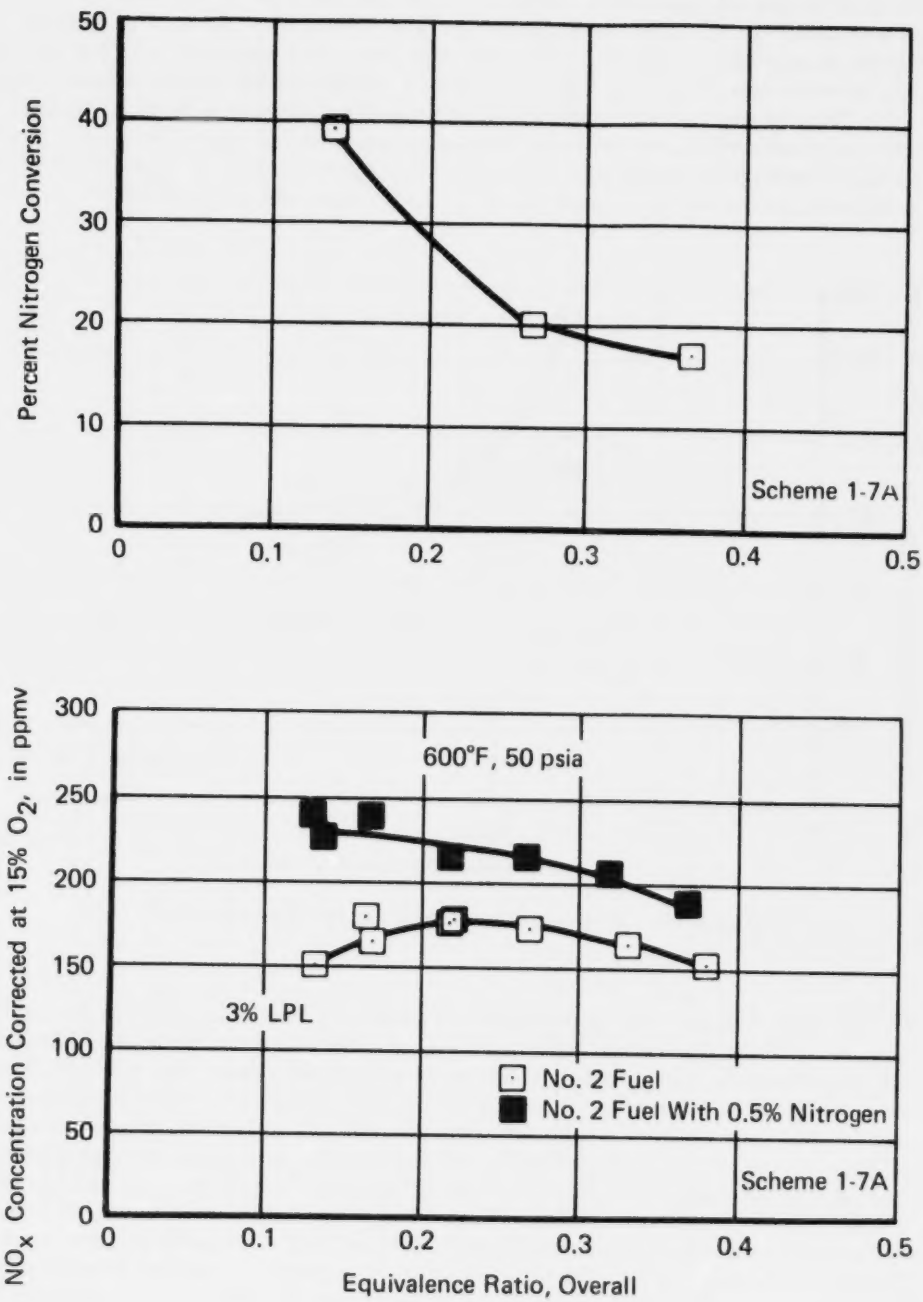


Figure 29. Variation in NO_x Concentration and Rate of Bound Nitrogen Conversion With Equivalence Ratio for Concept No. 1 — Low Intensity Flame

Additional data showing the effect of liner pressure loss on NO_x concentration levels in Scheme 1-7A are presented in Figure 30. The tests represented were all conducted using No. 2 fuel with 0.5% bound nitrogen. With reference to the baseline data of 3% liner pressure loss, NO_x concentrations at 1% LPL were greater at low equivalence ratios, but declined and became lower as equivalence ratio was increased. This result was consistent with the view that lower liner pressure loss causes less vigorous turbulent mixing within the burner (particularly between the flame jet and the surrounding air), and therefore produces a flame jet that is more nearly self-contained and dependent upon its own average internal equivalence ratio. A jet of this type would cause more burning to take place at fuel-rich internal equivalence ratios, and would produce a decline in NO_x concentration as equivalence ratios are increased.

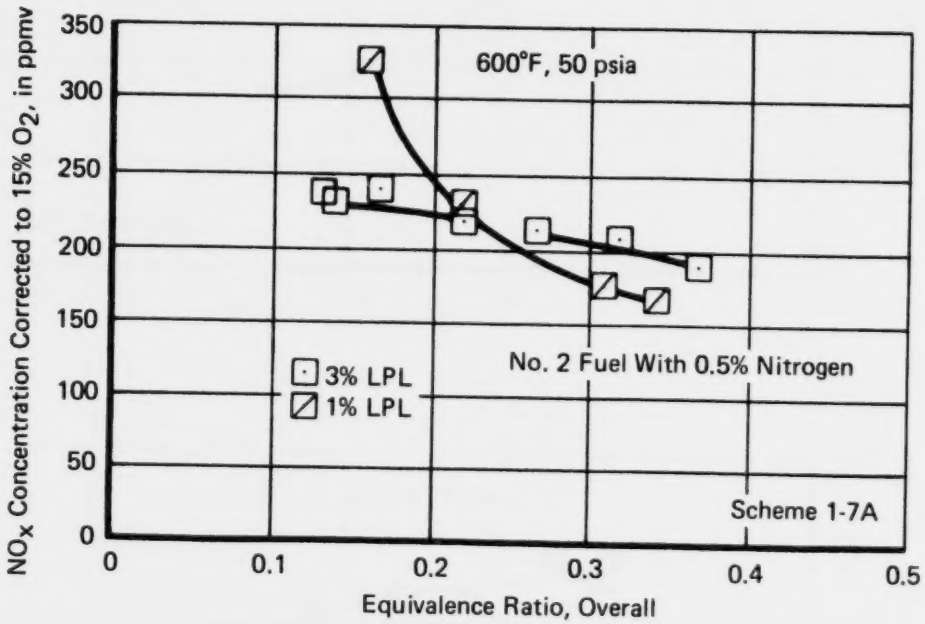
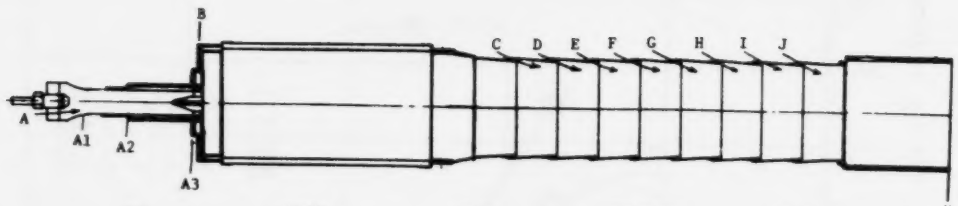


Figure 30. Exhaust Emission Data for Scheme 1-7A

Scheme 1-8A. Scheme 1-8A is depicted in Figure 31. Three main features distinguished this configuration from those already discussed: (1) an outer concentric premixing passage was provided in addition to the central passage employed in Schemes 1-5A, 1-6A, 1-7A; (2) a swirler was mounted in the discharge plane of the outer passage; (3) a ten-inch long ceramic liner section was inserted into the burner, between the dome, and the louver-cooled main section. The purpose of the outer premixing passage was to investigate the hypothesis that injecting fuel into the region of turbulent mixing between the central flame jet and the airflow surrounding it might constitute a means of reducing (chemically) some of the NO_x already formed. This approach was derived from tests performed with automobile engines in which a lean ethane/air mixture was injected into the exhaust manifold to achieve reburning of the near-stoichiometric products of combustion discharged from the cylinders (see reference 1). In Scheme 1-8A a design point equivalence ratio of 0.5 was selected for the outer premixing passage. The purpose of the ceramic liner section was to eliminate film cooling airflow in the forward end of the burner so that the turbulent mixing region around the jet could be more carefully controlled.



LB	AREF	L/D	VOLREF	ACOSUM
40.53	19.63	8.10	638.0	5.54

STATION	AX	ACD
A	2.924	0.602
A1	0.828	0.0
A2	2.221	0.0
A3	2.221	0.404
B	19.079	1.247
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.248
I	19.625	0.183
J	19.625	0.183
X	113.040	1.316

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	9.00	2.66	0.0
BST2	16.00	2.50	0.0
BST3	23.00	2.50	0.0

Figure 31. Bench-Scale Combustor Scheme 1-8A

Tests of Scheme 1-8A were conducted at three values of outer passage equivalence ratio (including zero). The emission concentration data obtained are presented in Figure 32. In that figure, the outer and inner premixing passages have been designated primary and secondary, respectively, in keeping with the nomenclature used on the test stand. The curves for both settings of primary (outer passage) fuel flow, and for secondary (inner passage) operation alone all exhibited high NO_x concentration levels at the lower equivalence ratios, and a steady decline as equivalence ratio is increased. These results were consistent with those obtained for Schemes 1-5A and 1-6A, and the same comments made for those schemes can be applied to Scheme 1-8A as well: (1) the high levels measured are indicative of diffusion burning at the lower equivalence ratios; (2) the decline in NO_x concentration can be attributed to an increase in the proportion of fuel-rich burning as equivalence ratio is increased. This change probably occurs as the quantity of fuel injected into the forward end of the burner consumes all the airflow present and available for diffusion burning on the boundary of the flame jet. A noteworthy feature of the data is that both curves for primary (outer passage) operation are higher than the one for secondary (inner passage) operation at the lower equivalence ratios. This result seems to indicate that, in transferring fuel from the inner to the outer passage (with the overall equivalence ratio constant), the quantity of NO_x generated increases significantly because additional fuel has been added to the diffusion burning zone. This observation tends to confirm the hypothesis that much of the NO_x formed originates in a large, turbulent diffusion burning zone located between the central flame jet and the burner liner. In the tests conducted, no beneficial effect of supplying fuel to the outer passage (at locally lean or near-stoichiometric equivalence ratios) was found.

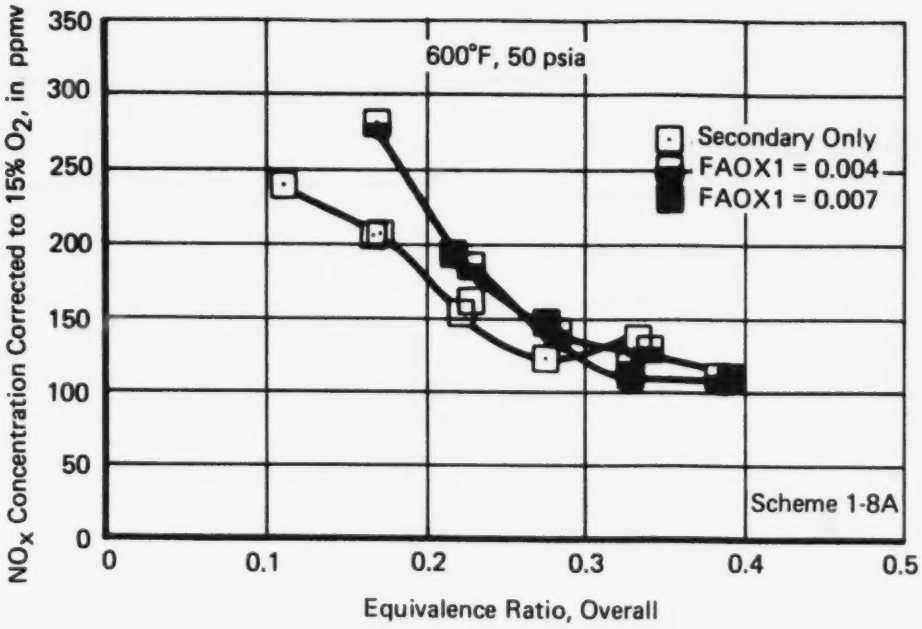
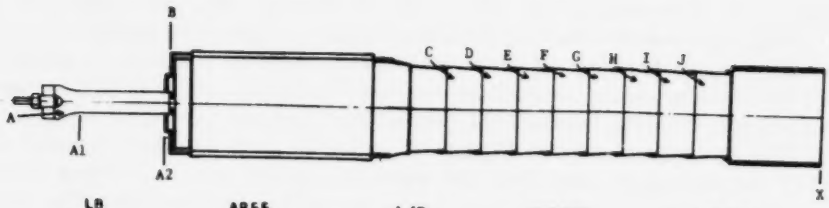


Figure 32. Exhaust Emission Data for Scheme 1-8A

Scheme 1-9A. This scheme marked a return to single premixing passages. The configuration was identical to that for Scheme 1-8A except for the elimination of the outer premixing passage and the addition of a new flameholder to the inner passage. The new flameholder, shown in Figure 33, consisted of an axial swirler with an open center. This arrangement was intended to provide high axial velocities for forming a central flame jet, and to foster a low degree of swirl for adequate but not excessive, mixing.

The variation in NO_x concentration with equivalence ratio and liner pressure loss (LPL) is shown in Figure 34. As in the previous case for Scheme 1-8A, the results for Scheme 1-9A show that NO_x was high at low equivalence ratios, and declined steadily as equivalence ratio was increased. Variations in liner pressure loss above and below a nominal value of 4%, resulted in lower NO_x concentrations at the higher equivalence ratios, and (in the one case investigated, 2% LPL) higher NO_x concentrations at the low end. These results were the same as those already stated for Scheme 1-8A and (in the case of variations in NO_x with LPL) for Scheme 1-7A. The initial sharp increase in NO_x concentrations at lower equivalence ratios, which had been deduced for several of the previous schemes, was actually measured for the first time in the case of Scheme 1-9A.



LB	AREF	L/D	VOLREF	ACDSUM
40.15	19.63	8.03	638.0	5.03

STATION	AX	ACD
A	0.916	0.596
A1	0.828	0.0
A2	2.221	0.0
B	19.079	1.247
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.248
I	19.625	0.183
J	19.625	0.183
X	113.040	1.222

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	9.00	2.66	0.0
BST2	16.00	2.50	0.0
BST3	23.00	2.50	0.0

Figure 33. Bench-Scale Combustor Scheme 1-9A

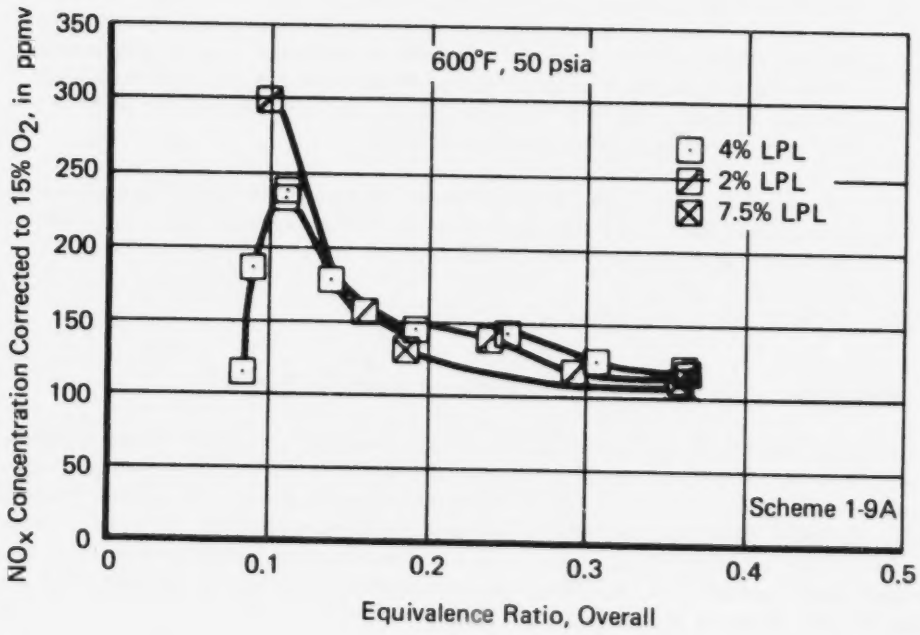


Figure 34. Exhaust Emission Data for Scheme 1-9A

Scheme 1-10A. This scheme was very similar to Scheme 1-9A, and it produced the most promising results obtained with the Low Intensity Flame Concept. The configuration, shown in Figure 35, was set up by blocking off the swirler at this discharge plane of the premixing tube in Scheme 1-9A. By eliminating the influence of swirl from the burner in this manner, it was hoped that the rate of mixing between the central flame jet and the surrounding gases might be reduced. The test data shown in Figure 36, indicated that this desired result had been achieved. NO_x concentrations were low (100 ppmv) compared to the previous schemes and were very nearly constant over the entire range of equivalence ratios tested. The results were similar to those of Scheme 1-7A in the sense that a horizontal NO_x curve was obtained. As in the case of Scheme 1-7A, this characteristic can be interpreted as evidence that NO_x was formed by diffusion burning. In addition, the fact that the NO_x concentration curve for Scheme 1-10A was lower than the one for Scheme 1-7A indicates that the proportion of diffusion burning was higher in the latter case.

The results obtained and the conclusions formulated in the tests conducted with Concept No. 1 are summarized below.

1. Elongated flames can be established by providing high jet velocities and small jet diameters.

2. The degree of interaction between the central flame jet and the surrounding airflow has a strong effect on NO_x concentration levels. Any influence that serves to increase the rate of mixing in the region around the jet (e.g., the presence of swirl, excessive local cooling airflow, or, tentatively, increased liner pressure loss) tends to increase the proportion of diffusion burning occurring in the burner.

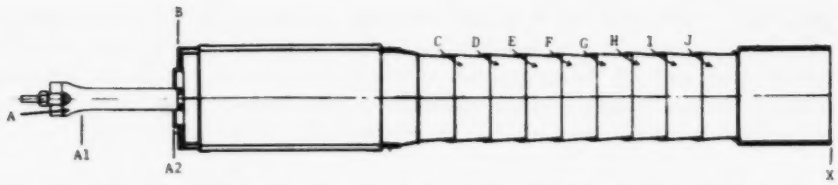
3. Diffusion burning on the boundary of the central flame jet cannot be eliminated altogether. A minimum amount is necessary for flame stabilization in the region along the boundary of the central flame jet. The ultimate success of the concept appears to depend on confining a major proportion of the burning to the interior of central flame jet where fuel-rich conditions prevail, and on verifying that the NO_x necessarily formed by diffusion burning can be reduced to acceptable levels.

4. The most successful configuration tested (Scheme 1-10A) had high primary zone and jet interior equivalence ratios, high jet velocity, a low jet to can diameter ratio, and no swirl. These features are summarized in Table VI.

5. Concept No. 1 was retired.

3.3.2 Evaluation of Concept No. 2 — Premixing Catalytic Burner

Catalytic burner concepts were excluded from screening under the Phase II bench-scale program. However, at the request of and under the direction of the EPA, and by cooperation between two EPA contractors (Pratt & Whitney Aircraft Group of United Technologies Corporation under EPA Contract 68-02-2136, and Aerotherm Division of Acurex Corporation under EPA Contract 68-02-2116), tests of an advanced-concept catalytic combustor provided by Acurex were conducted in the P&WA bench-scale test facility. The experimental program and test results obtained are presented in Appendix C.



Lb	AREF	L/D	VOLREF	ACDSUM
40.15	19.63	8.03	638.0	4.78

STATION	AX	ACD
A	0.360	0.360
A1	0.828	0.0
A2	2.221	0.0
B	19.079	1.247
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.248
I	19.625	0.183
J	19.625	0.183
X	113.040	1.211

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	9.00	2.66	0.0
BST2	16.00	2.50	0.0
BST3	23.00	2.50	0.0

Figure 35. Bench-Scale Combustor Scheme 1-10A

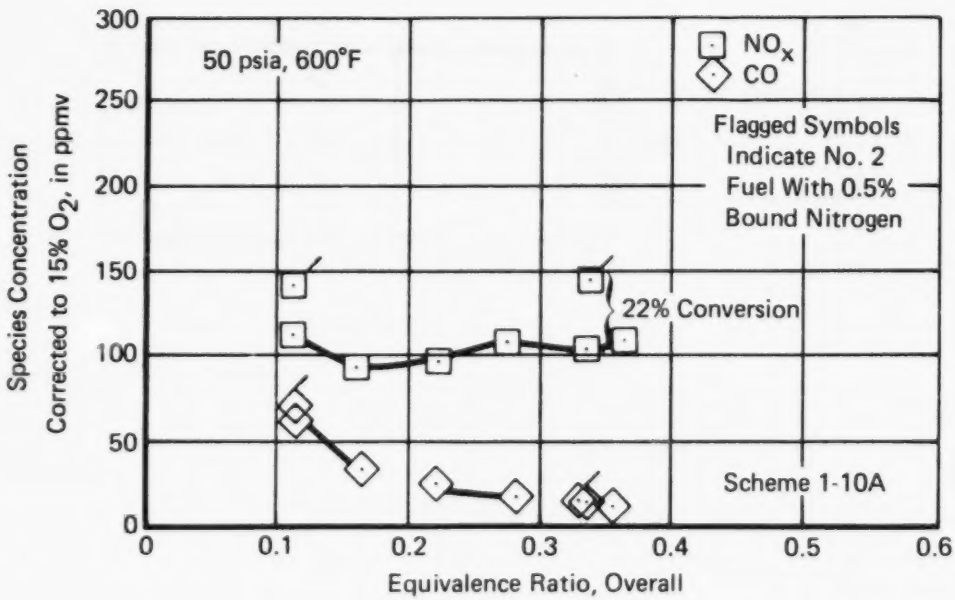
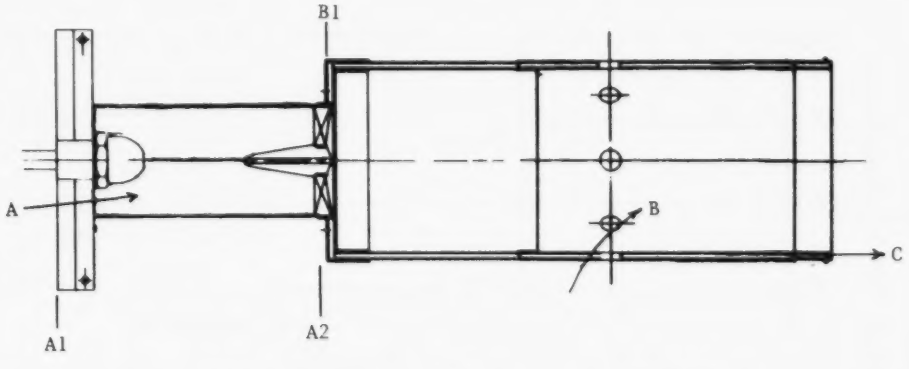


Figure 36. Exhaust Emission Data for Scheme 1-10A

3.3.3 Evaluation of Concept No. 3 — Superlean With Heat Recirculation

The evaluation of Concept No. 3, superlean with heat recirculation, addressed two main objectives: (1) the determination of baseline performance of the bench-scale lean-front-end (premixed) combustor; and (2) determination of the improvements in exhaust emissions that might be effected by preheating airflow directed to the premix tube. Preheating was accomplished in a heat exchanger mounted in the midsection of the combustor.

The initial configuration tested, Scheme 3-2A (Figure 37) consisted of the basic lean-front-end combustor hardware and did not include provisions for heat recirculation. A centrally mounted VADO (variable area dual orifice) fuel nozzle was employed, mounted in a three-inch diameter premix tube. This combination of components was selected to provide high front-end airflow for lean design point operation. The experimental hardware is shown in Figure 38. Tests were conducted at high rig pressure (200 psia) and high inlet air temperature (800°F) to investigate operation of the combustor under relatively severe conditions. Difficulties were encountered in the operation of the premix tube. Upon ignition of the burner (accomplished by injection of TEB, a pyroforic liquid, into the premix tube), flame was stabilized in the wake of the fuel injector at the entrance section of the premix tube. As a result, the flameholder (swirler) located at the discharge plane of the premix tube was overheated and destroyed. Damage to sections of the burner liner was also sustained. Examination of the fuel nozzle after the test revealed deposits of carbon over the upstream surfaces of the nozzle assembly, indicating that liquid had been caught in a reverse flow pattern along the outside surface. It was conjectured that the aerodynamic blockage of the fuel injector had been excessive, causing regions of recirculating flow to form and resulting in the stabilization of flame. Exhaust emission data were not recorded. The principal conclusion drawn from this brief test was that the VADO fuel nozzle should be replaced by an alternative design with less blockage, and that the premix tube air velocity should be increased in subsequent configurations.



LB	AREF	L/D	VOLREF	ACDSUM
20.50	19.09	4.16	391.3	5.44

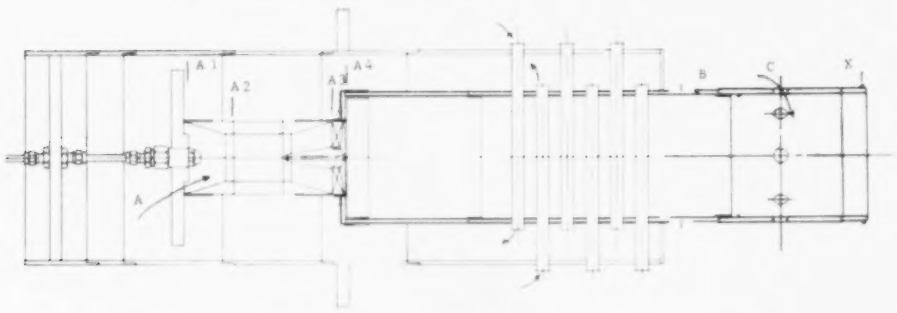
STATION	AX	ACD
A1	6.739	0.0
A2	6.739	0.0
A	6.739	3.011
B1	19.079	0.0
B	19.079	1.178
C	19.079	1.247

Figure 37. Bench-Scale Combustor Scheme 3-2A

Figure 38. Experimental Hardware for Scheme 3-2A

Modifications were made to the premix tube to eliminate further occurrences of flashback, drawing upon the results of tests of Concept No. 4, Superlean With Preburner (again, note that while the concepts are reported in order, testing was not consecutive), which had similar design requirements. Subsequent testing of Concept No. 3 was carried out with the air heat exchanger in place. Scheme 3-3A, shown in Figure 39, featured a revised premix tube design (which included a low-blockage fuel injector, and a high-velocity premixing passage), and a swirler-stabilized primary zone flame. The experimental components are shown in Figure 40 (the heat exchanger module prior to assembly) and Figure 41 (the final assembly with outer shroud removed). Tests were conducted at a chamber pressure of 50 psia and an inlet air temperature of 600°F using No. 2 fuel oil. The heat recirculation feature of the concept functioned well with no distress of the heat exchanger tubes being experienced. Premix tube air temperature was increased from 600°F, the nominal inlet temperature level, to approximately 740°F. Testing was generally confined to lower values of fuel-air ratio in order to avoid overheating the heat-exchanger tubes; however, this choice of operating condition proved to be in the range of interest for maintaining low NO_x emission concentrations. The lowest NO_x levels were acquired near lean blowout for the experimental arrangement used; at values of overall equivalence ratio slightly higher, the NO_x concentration increased very rapidly.

Reproduced from
best available copy.



LB	AREF	L/D	VOLREF	ACOSUM
31.60	19.63	0.32	406.8	5.11

STATION	AR	ACO
A	0.739	2.540
A1	0.739	0.0
A2	0.739	0.0
A3	0.739	0.0
A4	19.079	0.0
B	19.079	1.187
C	19.079	0.574
X	113.040	0.509

MEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
RST1	3.75	1.25	0.0
RST2	9.50	1.46	0.0
RST3	17.50	0.80	0.0
RST4	17.50	2.50	0.0

Figure 39. Bench-Scale Combustor Scheme 3-3A

FAE 152110

Figure 40. Air Heat Exchanger Module Used in the Evaluation of Concept No. 3 — Superlean With Heat Recirculation

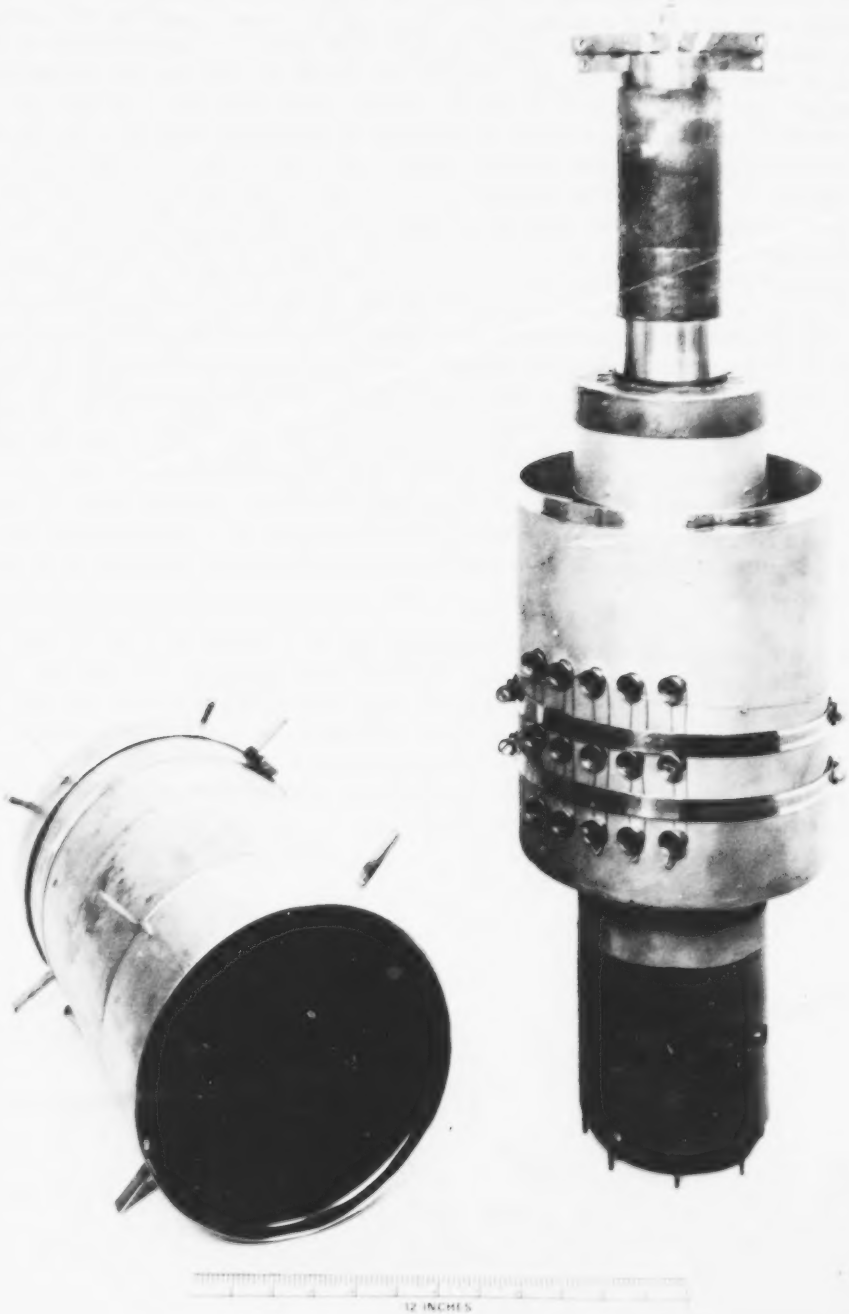
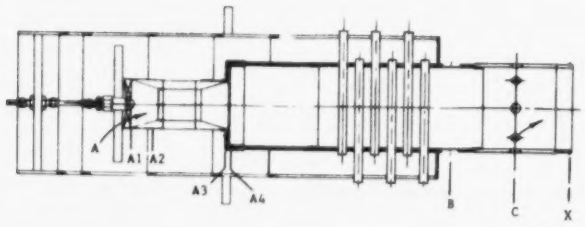


Figure 41. Experimental Hardware for Scheme 3-3A

Three other configurations were subsequently tested, featuring modifications directed toward lower intensity flameholding and better premixing of the fuel and recirculated air. Scheme 3-4A (Figure 42) incorporated an alternative flameholding scheme (air swirl vanes at the premix tube inlet and a dump at the exit). These modifications represented an attempt to stabilize the flame under conditions of lower-intensity turbulence (to preclude blowout due to flame stretch at lean fuel-air ratios), and reduced stay times (to preclude the entrapment of reactants within high temperature recirculation zones). Under fuel-lean burning conditions, attainment of these objectives was expected to bring about concurrent reductions in CO (which increases exponentially at the onset of lean blowout) and NO_x (which is time-temperature dependent and tends to increase in response to the same factors that enable high intensity burning to take place). Further revisions were investigated in Scheme 3-5A (Figure 43), which featured a flamespreading device, and in Scheme 3-6A (Figure 44) which featured a gradual expansion flameholder. The most successful configuration was Scheme 3-4A. A comparison of NO_x and CO data for Schemes 3-4A and 3-6A is shown in Figure 45. Although Scheme 3-6A produced higher levels of both constituents, there were noteworthy features in the test results. With reference to the dump flameholder of Scheme 3-4A, the gradual-expansion flameholder in Scheme 3-6A produced a NO_x curve that was shifted to the left (toward lower equivalence ratios), but produced a CO curve that was virtually identical The resultant "scissors effect," seen in comparing the two plots in Figure 45 resulted in the crossover point of the NO_x and CO curves being shifted upward to about 180 ppmv for the gradual-expansion flameholder, from about 80 ppmv for the dump flameholder. The significance of this "scissors effect" is that the tradeoff between NO_x and CO had been altered, and although the new configuration represented a step backward in this tradeoff, these results served to illuminate some of the controlling design features involved.

In the tests conducted of various configurations of Concept No. 3, no substantial reductions in the production of NO_x were realized. The tradeoffs encountered between NO_x and CO appeared to be typical of lean-burning in general, and did not reflect any noticeable improvement due to the recirculation of heat to aid in fuel prevaporation and premixing. Tests involving lean combustion were continued in the evaluation of several other concepts, including Concept No. 7, Staged Centertube Burner, in which substantial reductions in NO_x were achieved. Concept No. 3 was retired.

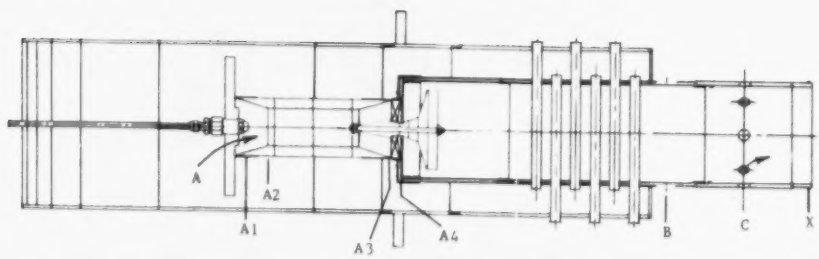


LB	AREF	L/D	VOLREF	ACDSUM
31.60	19.63	6.32	406.8	5.02

STATION	AX	ACD
A	6.739	2.540
A1	6.739	0.0
A2	2.909	0.0
A3	6.739	0.0
A4	19.079	0.0
B	19.079	1.187
C	19.079	0.974
X	113.040	3.317

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.75	1.25	0.0
BST2	9.50	1.46	0.0
BST3	17.50	0.0	0.0
BST4	17.50	2.56	0.0

Figure 42. Bench-Scale Combustor Scheme 3-4A

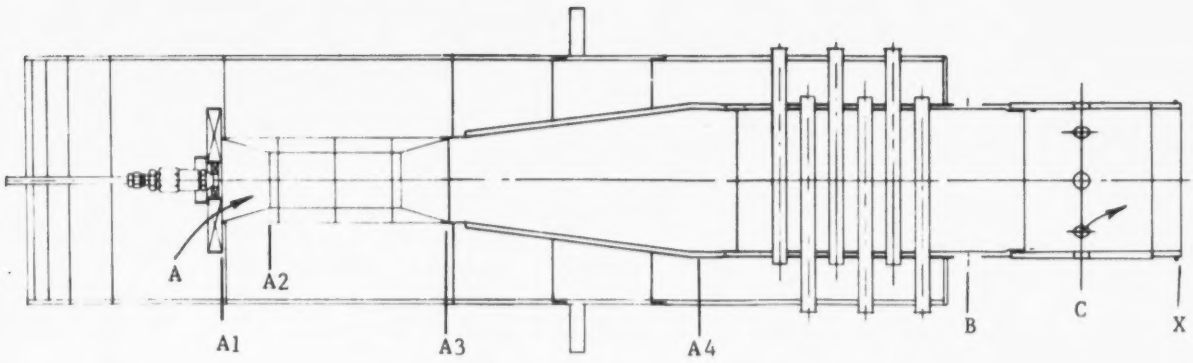


LB	AREF	L/D	VOLREF	ACDSUM
39.60	19.63	7.92	406.8	2.54

STATION	AX	ACD
A	6.739	2.540
A1	6.739	0.0
A2	2.909	0.0
A3	6.739	0.0
A4	19.079	0.0
B	19.079	1.187
C	19.079	0.974
X	113.040	0.258

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.75	1.25	0.0
BST2	17.50	1.46	0.0
BST3	25.50	0.0	0.0
BST4	25.50	2.56	0.0

Figure 43. Bench-Scale Combustor Scheme 3-5A



LB	AREF	L/D	VOLREF	ACDSUM
39.60	19.63	7.92	406.8	5.38

STATION	AX	ACD
A	6.739	2.540
A1	6.739	0.0
A2	2.909	0.0
A3	6.739	0.0
A4	19.079	0.0
B	19.079	1.187
C	19.079	0.974
X	113.040	0.679

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	5.32	1.25	0.0
BST2	13.57	1.46	0.0
BST3	25.50	0.0	0.0
BST4	25.50	2.56	0.0

Figure 44. Bench-Scale Combustor Scheme 3-6A

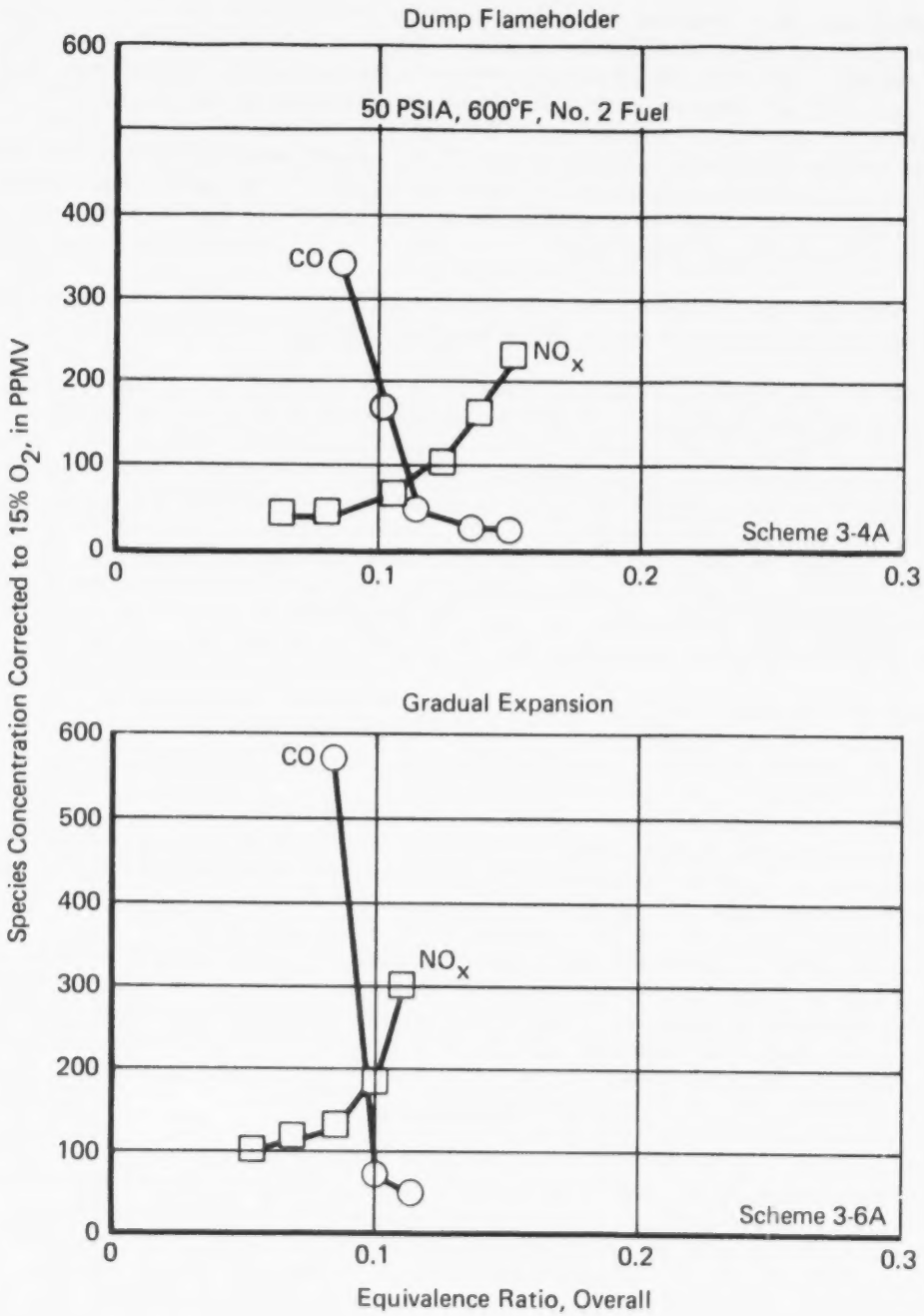


Figure 45. Comparison of Variation in NO_x and CO Concentrations With Equivalence Ratio for Two Flameholder Types in Concept No. 3 (Superlean With Heat Recirculation)

3.3.4 Evaluation of Concept No. 4 — Superlean With Preburner

Limited tests were conducted with several secondary concepts that involve lean burning. The first was Concept No. 11 (Distributed Flame). These tests were generally unsuccessful because of preignition in the premixing tube section of the combustors. Qualitatively, it was learned that the fuel vaporizer module developed for use primarily under rich-front-end conditions in Concept No. 5 (see Section 3.3.5) had a pronounced tendency to cause preignition when used in a lean premixing environment. Insufficient exhaust emission data were obtained to make even a qualitative comparison of various flameholders to the swirlers more conventionally employed. In Figure 46 a photograph of the bench-scale hardware used in the evaluation of Concept No. 4 is presented.

Initial testing was directed toward achieving a stable uniformly burning fuel-air mixture in the front-end and preburner regions of the bench-scale burner configurations.

Schemes 4-1A and 4-2A, shown in Figures 47 and 48, respectively, featured a premixed pilot operating at near stoichiometric conditions, and the introduction of the main complement of fuel through wall-mounted injectors. Scheme 4-2A differed from 4-1A in that the fuel-air premixing tube was shortened to gain access to the secondary fuel injectors to facilitate their cleaning. The objective of initial testing was to acquire a preburner/mainburner system that could provide thorough vaporization of fuel and complete mixing of fuel and air prior to combustion. Ambient-pressure tests were conducted at an inlet-air temperature of 600°F at three values of fuel-air ratio. Only visual observations were made; no attempt was made to acquire emissions data. The secondary fuel appeared to ignite at the point of injection rather than to undergo vaporization and premixing with air prior to igniting and burning.

Schemes 4-3A and 4-4A are shown in Figures 49 and 50, respectively. Scheme 4-4A differed from 4-3A in that the length between the pilot and secondary fuel injector was reduced.

These schemes differed from Schemes 4-1A and 4-2A in that the main premix tube airflow was restricted to produce a fuel-rich mixture. Operation of the combustor in this mode allowed the fuel-vaporization function to be studied apart from the admixing of air to achieve an overall lean condition.

Ambient-pressure tests were conducted at an inlet-air temperature of 600°F at four values of fuel-air ratio. Only visual observations were made during these tests. Subsequent tests were conducted at a chamber pressure of 50 psia at an inlet-air temperature of 600°F; emission measurements were made during these tests. Secondary fuel appeared to ignite at the point of injection (as in the tests of Schemes 4-1A and 4-2A). NO_x readings indicated droplet burning.

The final tests of Concept No. 4 addressed the design of the pilot module (preburner) only and were conducted in the auxiliary 'pilot rig.' Various arrangements of an air-boost fuel nozzle and various pilot-burner swirler positions were tested. Visual observations were recorded (no emissions data taken) and comparisons of flame stability were made. The test results indicated that the use of sonic (air-boost) fuel nozzles and a short premixing tube within the pilot module did not improve either compactness or flame stability. The flame stability of all configurations of the pilot module was found to be marginal at atmospheric pressure and ambient inlet air temperature, although generally satisfactory at 50 psia. These results indicated that further refinement of the hardware was required if this general method of fuel vaporization were pursued. Although further tests were conducted with the same hardware in conjunction with Concept No. 5 — Heat Removal (see Section 3.3.5) and with Concept No. 28 — Rich Preburner (see Section 3.3.28), the preburner approach was eventually retired.

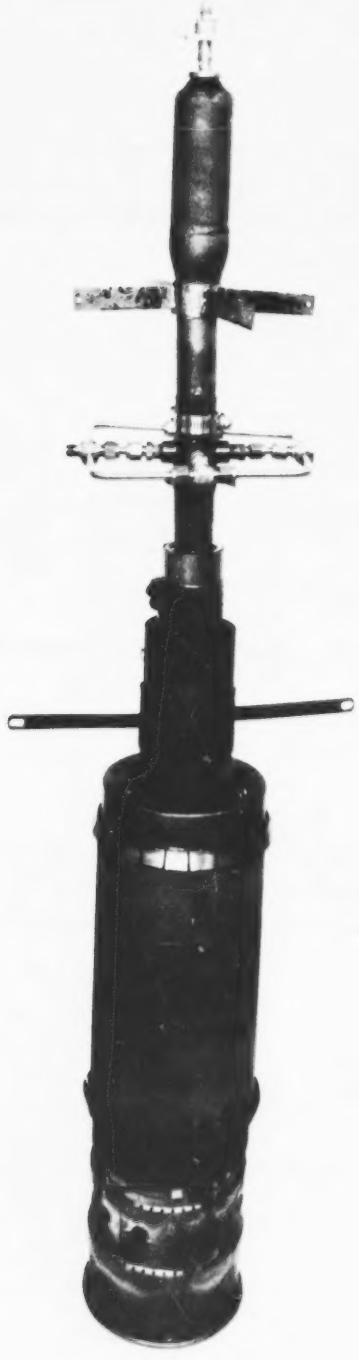
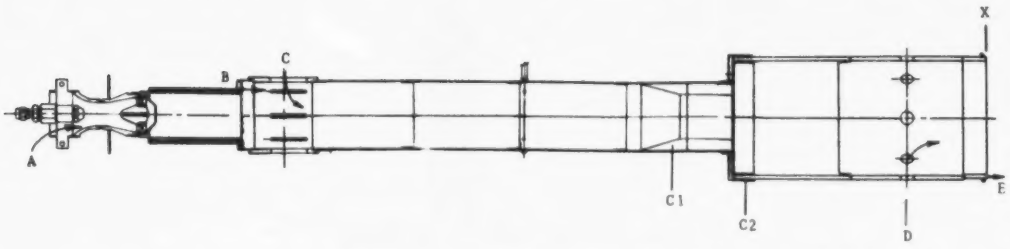


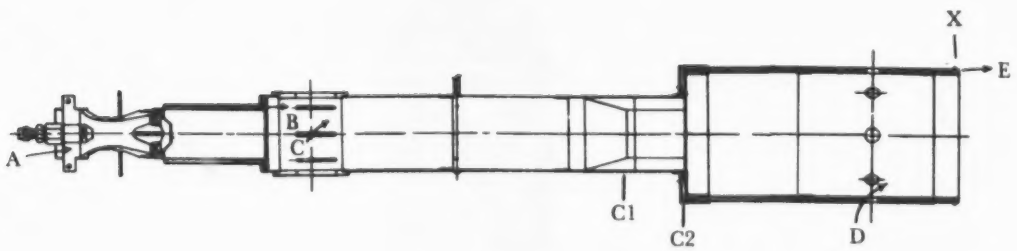
Figure 46. Experimental Hardware Used in the Evaluation of Concept No. 4 — Superlean With Preburner



LB	AREF	L/D	VOLREF	ACDSUM
0.0	0.0	0.0	0.0	5.31

STATION	AX	ACD
A	0.785	0.704
B	3.538	0.663
C	6.739	1.726
C1	2.909	0.0
C2	19.079	0.0
D	19.079	0.974
E	19.079	1.247
X	113.040	0.0

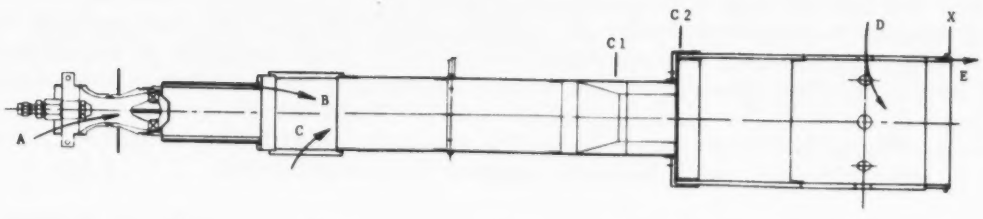
Figure 47. Bench-Scale Combustor Scheme 4-1A



LB	AREF	L/D	VOLREF	ACDSUM
31.50	19.09	6.39	210.0	5.27

STATION	AX	ACD
A	0.785	0.659
B	3.538	0.663
C	6.739	1.726
C1	2.909	0.0
C2	19.079	0.0
D	19.079	0.974
E	19.079	1.247
X	113.040	0.0

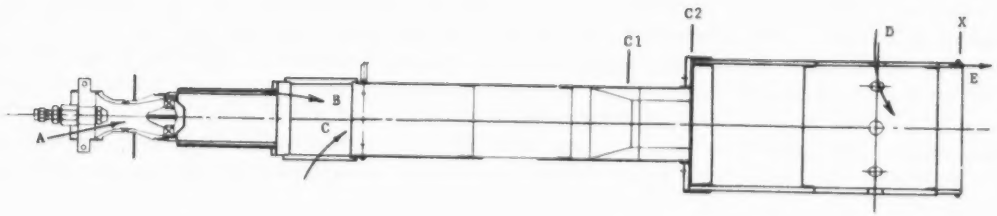
Figure 48. Bench-Scale Combustor Scheme 4-2A



LB	AREF	L/D	VOLREF	ACDSUM
0.0	0.0	0.0	0.0	3.03

STATION	AX	ACD
A	0.765	0.704
B	3.538	0.075
C	6.739	0.0
C1	2.909	0.0
C2	19.079	0.0
D	19.079	0.974
E	19.079	1.274
X	113.040	0.0

Figure 49. Bench-Scale Combustor Scheme 4-3A



LB	AREF	L/D	VOLREF	ACDSUM
37.50	19.09	7.61	326.5	2.74

STATION	AX	ACD
A	0.442	0.442
B	3.538	0.075
C	6.739	0.0
C1	2.909	0.0
C2	19.079	0.0
D	19.079	0.974
E	19.079	1.247
X	113.040	0.0

Figure 50. Bench-Scale Combustor Scheme 4-4A

3.3.5 Evaluation of Concept No. 5 — Heat Removal

Extensive tests were conducted of Concept No. 5, Heat Removal. In addition to the central investigation which addressed the methods and benefits of heat extraction, various techniques for prevaporizing liquid fuels were evaluated. In particular, the preburner approach which had been initiated with Concept No. 4, Superlean with Preburner (see Section 3.3.4), was adapted to fuel-rich operation and refined. Results obtained with this approach were promising, although there were recurrent difficulties with carbon formation. At the conclusion of tests of the Heat Removal concept, further development of the preburner approach was carried out in conjunction with Concept No. 28, Rich Preburner (see Section 3.3.28). In the course of the evaluation of Concept No. 5, tests were also conducted firing natural gas in order to establish a baseline case representing complete fuel prevaporization.

Heat removal was accomplished using tubular heat exchangers of the design shown in Figure 51, with water employed as the coolant fluid. By making use of modular construction, individual heat exchangers were combined to form arrays of up to four modules (see Figure 52), and were positioned in various sections of the combustor. Tests were also conducted using an alternative heat exchanger design which allowed burner airflow to be used as the coolant fluid. The modular hardware used in these tests (see Figure 53) was originally used in the evaluation of Concept No. 3, Superlean with Heat Recirculation, (see Section 3.3.3).

The data, including exhaust emissions, obtained for the Heat Removal concept are presented in Appendix A. Special heat removal parameters are contained in Table A-4.

Initial tests were performed with Scheme 5-1A (Figure 54) which contained a single heat-exchanger module. The premix tube and aerodynamic swirler from Concept No. 1, Low Intensity Flame (Section 3.3.1) were employed. Ambient-pressure tests were conducted at an inlet temperature of 600°F over a range of fuel-air ratios at two rates of heat removal. Results were considered to be inconclusive because of a maldistribution of the flame profile resulting from the aerodynamic swirler.

Tests of Scheme 5-2A (Figure 55), which employed an alternate non-premixed front-end section, were conducted to examine flame stability and homogeneity. The heat exchanger that had been located in the flame tube downstream of the premixing tube in Scheme 5-1A was removed for these front-end optimization tests. Subsequent tests of Schemes 5-3A through 5-9A were also conducted without heat removal. Ambient-pressure tests were conducted over a range of fuel-air ratios at inlet-air temperatures of 600°F and 800°F. Only visual observations were made. The flame distribution appeared to be good; however, heterogeneous combustion predominated, probably as a result of an inadequate vaporization length in the swirl-cup region.

Further optimization of the front-end section of the combustor was subsequently undertaken. In Scheme 5-3A, the vane-type swirler was replaced by a premix tube which was recessed to provide a second fuel-vaporization/fuel-air premixing region prior to combustion (see Figure 56). Ambient-pressure tests were conducted at an inlet-air temperature of 800°F at three values of fuel-air ratio. Flame distribution appeared to be good; however, heterogeneous burning predominated within the premixing tube.

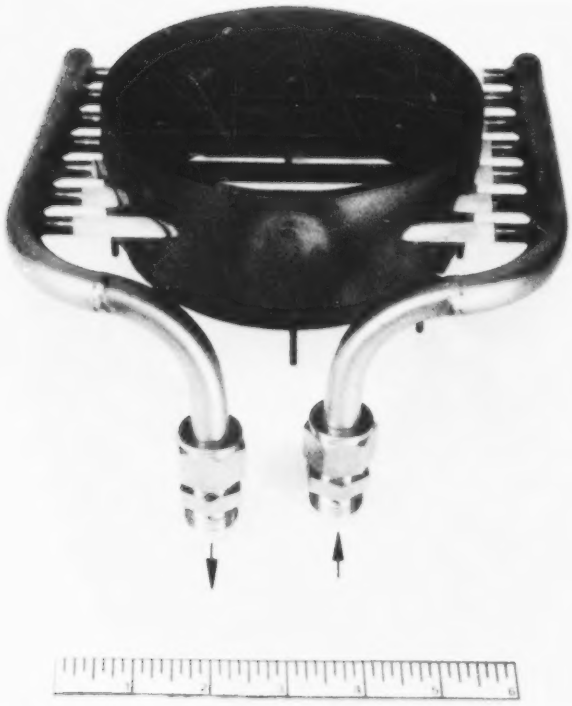


Figure 51. Basic Heat Exchanger Module Used in the Evaluation of Concept No. 5 — Heat Removal

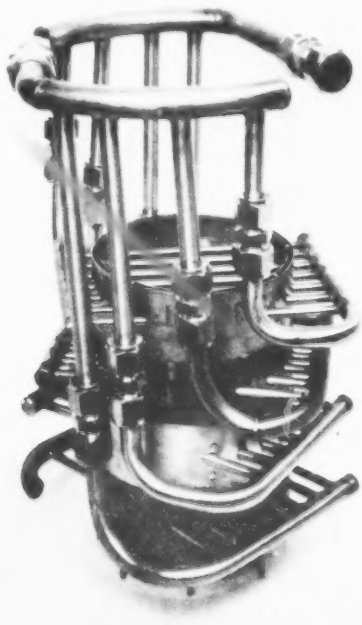


Figure 52. Array of Four Heat Exchanger Modules

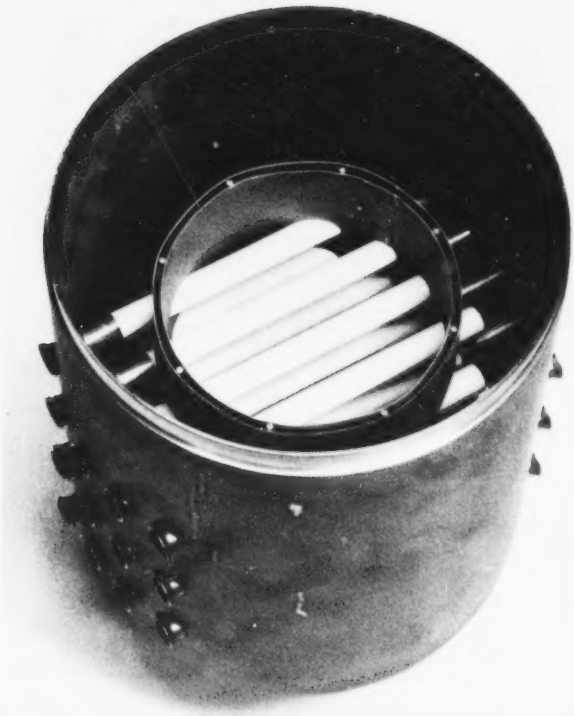
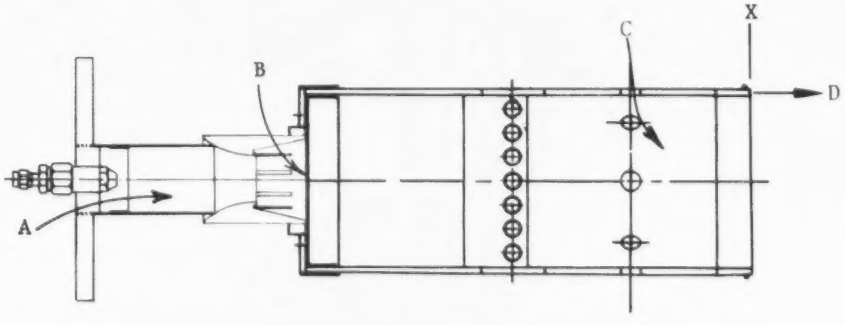


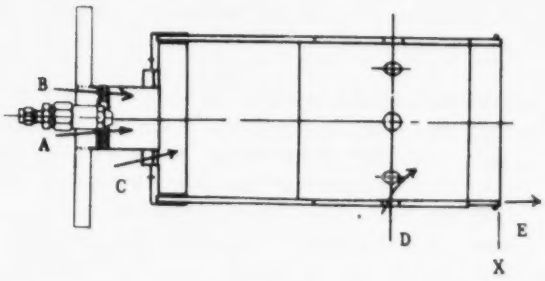
Figure 53. Alternative Heat Exchanger Hardware Utilizing Air as Coolant



LB	AREF	L/D	VOLREF	ACDSUM
20.75	19.09	4.21	243.4	2.70

STATION	AX	ACD
A	3.140	0.319
B	7.065	0.162
C	19.079	0.974
D	19.079	1.247
X	113.040	0.0

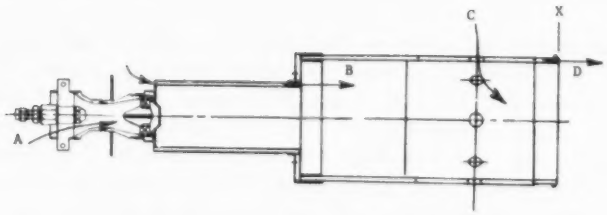
Figure 54. Bench-Scale Combustor Scheme 5-1A



LB	AREF	L/D	VOLREF	ACDSUM
13.00	19.09	2.64	248.2	3.53

STATION	AX	ACD
A	2.924	0.228
B	2.924	0.945
C	3.140	0.137
D	19.079	0.974
E	19.079	1.247
X	113.040	0.0

Figure 55. Bench-Scale Combustor Scheme 5-2A



LB	AREF	L/D	VOLREF	ACDSUM
21.00	19.09	4.26	210.0	3.55

STATION	AX	ACD
A	2.924	0.446
B	7.065	0.881
C	19.079	0.974
D	19.079	1.247
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	7.00	1.50	0.0
BST2	4.00	1.00	0.0
BST3	2.00	0.51	3.0
BST4	9.00	2.50	0.0

Figure 56. Bench-Scale Combustor Scheme 5-3A

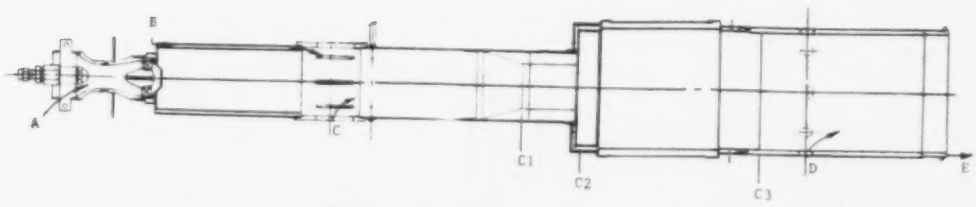
Schemes 5-4A and 5-5A (Figures 57 and 58) utilized the premix tube and upstream section from Scheme 5-3A as a preburner.

In Scheme 5-4A the secondary fuel was injected via orifices in a wall-mounted manifold; in Scheme 5-5A, the secondary fuel was injected via a single fuel nozzle located in the preburner exhaust gas stream. In both schemes a ceramic liner (tubular section of recrystallized silicon carbide) was incorporated in the primary zone of the reaction chamber downstream of the fuel-vaporization tube. Tests were conducted at a chamber pressure of 50 psia at an inlet-air temperature of 600°F over a range of fuel-air ratios. Exhaust emission concentrations were measured. NO_x readings again indicated that droplet burning predominated. With droplet burning predominating, combustion occurs largely at stoichiometric conditions. The effect this has on NO_x concentrations is generally to increase the measured amounts at both fuel-lean and fuel-rich conditions over that measured in a more prevaporized system.

In Schemes 5-6A through 5-9A further refinements were made in the arrangement of the preburner. These schemes, shown in Figures 59 through 62, represent variations in pilot configuration and in the location of the secondary fuel-injection site as part of an investigation of pilot-zone stability characteristics. The secondary fuel-injection system consisted of four fuel nozzles located at 90 deg spacing on the circumference of the fuel-vaporization tube at a fixed axial station; the secondary fuel was injected normal to the pilot-chamber exhaust stream. Tests were conducted at a chamber pressure of 50 psia at an inlet air-temperature of 600°F over a range of fuel-air ratios. Exhaust emission concentrations were measured. Interactions were encountered between the pilot chamber and the secondary fuel injectors. The pilot flame was apparently drawn into the secondary fuel jets in "ejector" fashion in the initial test. These two regions were successfully separated during subsequent test series. With the "best" hardware arrangement, NO_x readings indicated that progress had been made toward homogeneous burning with reduced concentrations at the higher equivalence ratio settings.

Schemes 5-10A and 5-11A (Figures 63 and 64) represented minor changes in the configuration of the preburner. Data were generated firing both neat No. 2 fuel oil, and pyridine-spiked No. 2 fuel oil (0.5 weight percent nitrogen). Subsequent tests were conducted firing natural gas. To accommodate gaseous fuel, the preburner was removed and replaced initially by a radial injector as shown in Figure 65 (Scheme 5-12A). The natural gas testing was included to simulate the physical situation in which the fuel entering the combustion chamber was fully vaporized (without having to incorporate a preburner), and was accomplished in a parallel path to allow for the development of the premix tube.

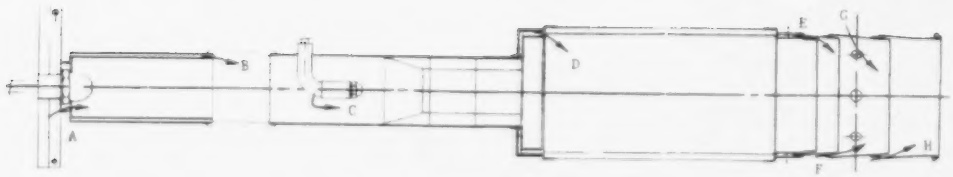
Variations in NO_x concentration with equivalence ratio for the aforementioned tests are shown in Figures 66 through 68. Data for neat No. 2 fuel oil at inlet air temperatures of 600°F and 800°F and for natural gas at an inlet air temperature of 600°F are shown in Figure 66. The data shown for the prevaporized No. 2 fuel oil and for the natural gas (except for one data point at an equivalence ratio of approximately 0.19) appear to be continuous: to belong to a common curve. This commonality was an initial indication that the preburner might have effectively transformed liquid No. 2 fuel oil into vapor prior to its being mixed with air and burned. Note that the preburner configuration was that of Scheme 5-11A/B/C.



LB	AREF	L/D	VOLREF	ACDSUM
0.0	0.0	0.0	0.0	3.13

STATION	AX	ACD
A	0.442	0.442
B	5.380	0.101
C	6.739	0.0
C1	2.909	0.0
C2	20.819	0.162
C3	19.079	0.0
D	19.079	1.178
E	19.079	1.247

Figure 57. Bench-Scale Combustor Scheme 5-4A

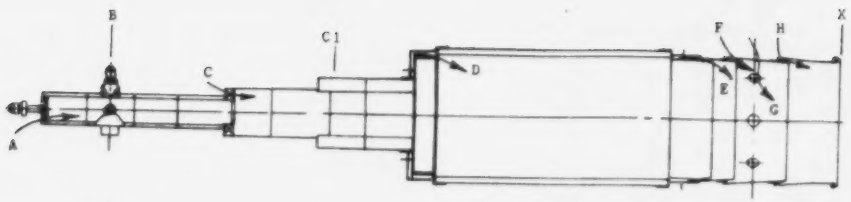


LB	AREF	L/D	VOLREF	ACDSUM
38.65	19.63	7.73	361.3	2.97

STATION	AX	ACD
A	1.227	0.183
B	5.380	0.101
C	6.739	0.061
D	20.819	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.50	1.50	0.0
BST2	5.75	1.50	0.0
BST3	14.00	1.50	0.0
BST4	32.50	2.50	0.0

Figure 58. Bench-Scale Combustor Scheme 5-5A

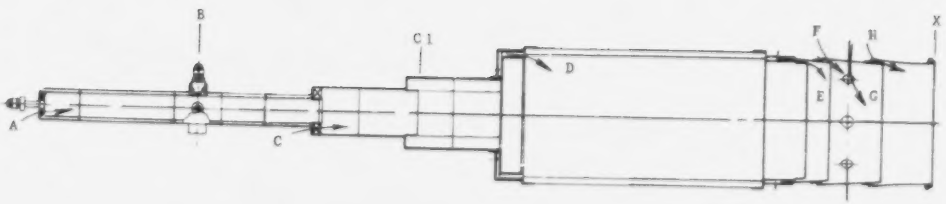


LB	AREF	L/D	VOLREF	ACDSUM
34.15	19.63	6.83	361.3	3.10

STATION	AX	ACD
A	0.864	0.030
B	0.864	0.0
C	2.924	0.450
C1	2.909	0.0
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.50	0.66	0.0
BST2	8.00	1.00	0.0
BST3	12.00	1.46	0.0
BST4	28.05	2.50	0.0

Figure 59. Bench-Scale Combustor Scheme 5-6A

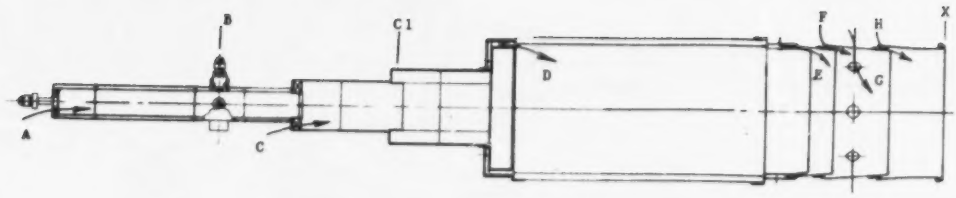


LB	AREF	L/D	VOLREF	ACDSUM
38.15	19.63	7.63	361.3	3.10

STATION	AX	ACD
A	0.864	0.030
B	0.864	0.0
C	2.924	0.450
C1	2.909	0.0
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.25	0.66	0.0
BST2	4.00	0.66	0.0
BST3	16.75	1.46	0.0
BST4	32.05	2.50	0.0

Figure 60. Bench-Scale Combustor Scheme 5-7A

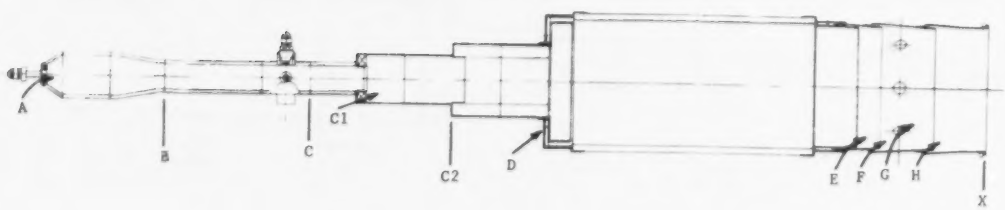


LB	AREF	L/D	VOLREF	ACDSUM
36.15	19.63	7.23	361.3	3.10

STATION	AX	ACD
A	0.864	0.030
B	0.864	0.0
C	2.924	0.450
C1	2.909	0.0
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.25	0.66	0.0
BST2	3.75	0.66	0.0
BST3	14.75	1.46	0.0
BST4	30.05	2.50	0.0

Figure 61. Bench-Scale Combustor Scheme 5-8A

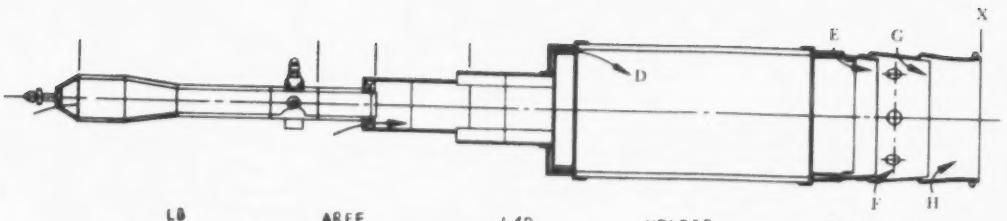


LB	AREF	L/D	VOLREF	ACDSUM
39.28	19.63	7.86	361.3	3.09

STATION	AX	ACD
A	0.196	0.017
B	0.586	0.0
C	0.864	0.0
C1	2.924	0.450
C2	6.647	0.0
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.65	0.95	0.0
BST2	5.50	0.66	0.0
BST3	17.88	1.46	0.0
BST4	33.18	2.50	0.0

Figure 62. Bench-Scale Combustor Scheme 5-9A

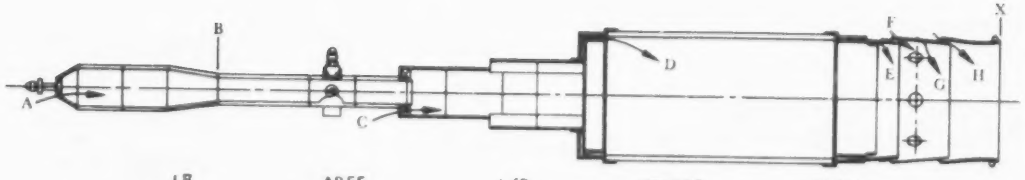


LB	AREF	L/D	VOLREF	ACDSUM
39.28	19.63	7.86	361.3	3.09

STATION	AX	ACD
A	0.196	0.017
B	0.586	0.0
C	2.924	0.450
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC
BST1	1.65	0.95
BST2	5.50	0.66
BST3	17.88	1.46
BST4	33.18	2.50

Figure 63. Bench-Scale Combustor Scheme 5-10A

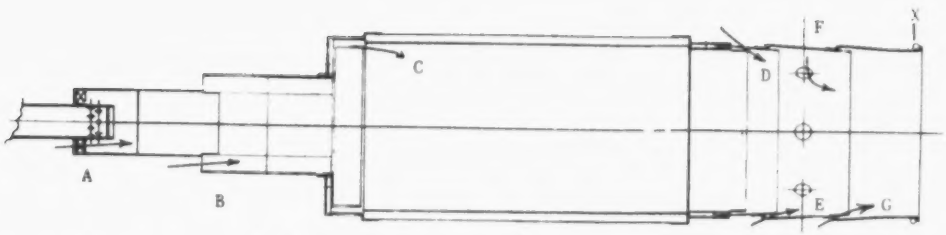


LB	AREF	L/D	VOLREF	ACDSUM
41.28	19.63	8.25	361.3	3.09

STATION	AX	ACD
A	0.196	0.017
B	0.586	0.0
C	2.924	0.450
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.65	0.95	0.0
BST2	3.65	0.95	0.0
BST3	8.90	0.66	0.0
BST4	16.90	1.46	0.0

Figure 64. Bench-Scale Combustor Scheme 5-11A



LB	AREF	L/D	VOLREF	ACDSUM
26.66	19.63	5.33	361.3	3.07

STATION	AX	ACD
A	2.924	0.450
B	2.924	0.0
C	20.619	0.162
D	19.625	1.247
E	19.625	0.119
F	19.625	0.974
G	19.625	0.119
X	113.040	0.0

Figure 65. Bench-Scale Combustor Scheme 5-12A

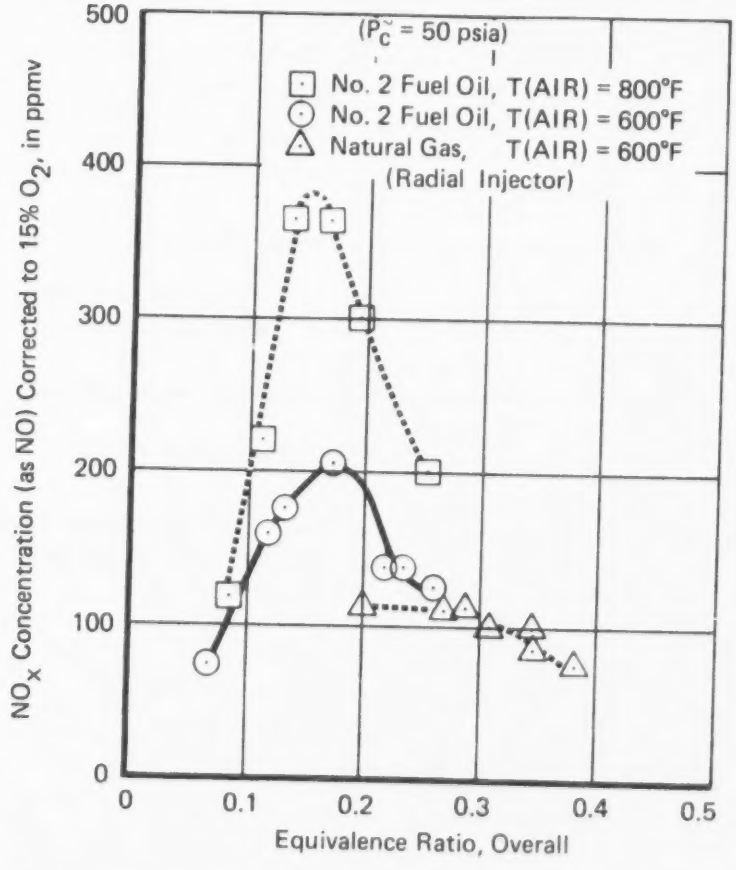


Figure 66. Variation in NO_x Concentration With Equivalence Ratio, Fuel Burned, and Inlet Air Temperature

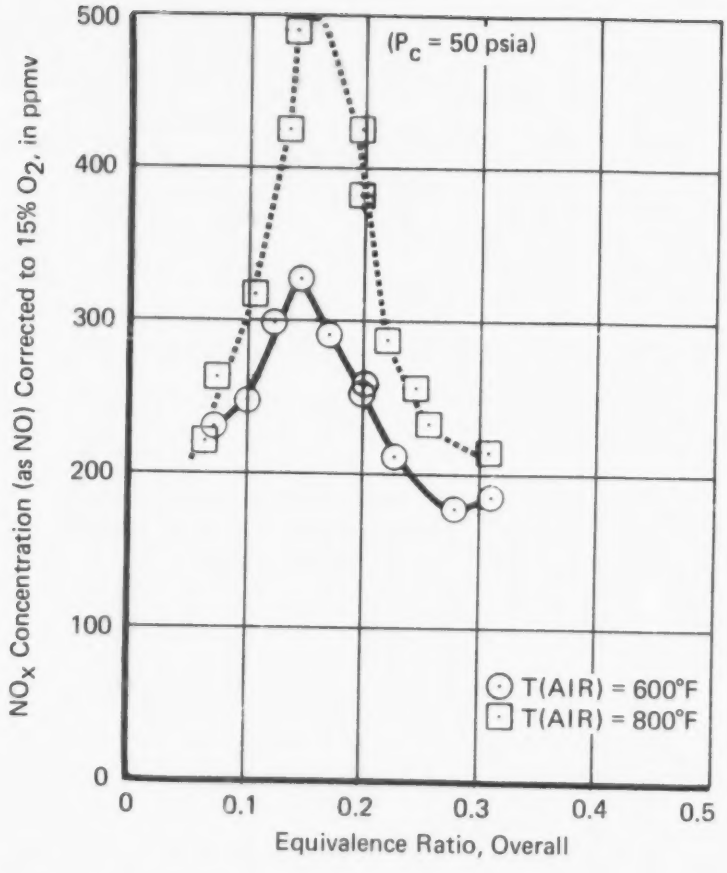


Figure 67. Variation in NO_x Concentration With Equivalence Ratio and Inlet Air Temperature for Adulterated (0.5% Nitrogen) No. 2 Fuel Oil

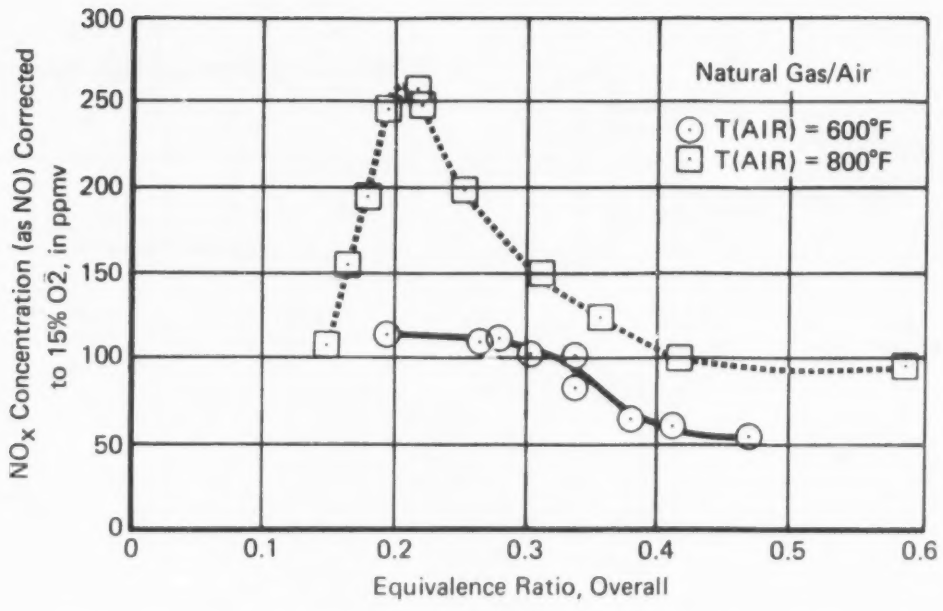


Figure 68. Variation in NO_x Concentration With Equivalence Ratio and Inlet Air Temperature for Radial Fuel Injection at 50 psia Chamber Pressure

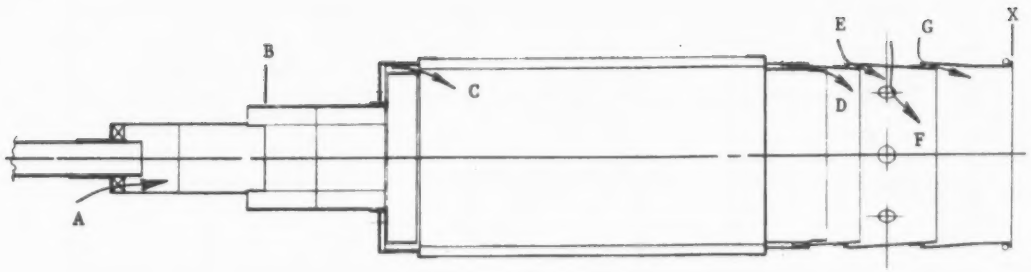
Figure 66 also shows the effect of inlet air temperature on NO_x concentration over a range of overall equivalence ratios. The trends shown are indicative of those for a combustion device operated over a combustible mixture range from fuel-lean, through stoichiometric, to fuel-rich.

The peak concentrations of NO_x were considerably higher, by nearly a factor of two, at an inlet air temperature of 800°F than at an inlet air temperature of 600°F. NO_x concentrations decreased rapidly as the overall equivalence ratio was both increased and decreased from the peak NO_x equivalence ratio. Obviously, for the burner configuration tested, it was more desirable to operate at overall equivalence ratios well away from 0.15.

In Figure 67 data for No. 2 fuel oil containing 0.5% nitrogen are shown for the tests conducted at inlet air temperatures of 600°F and 800°F. The values of NO_x obtained were higher than in the tests conducted with non-nitrogenous No. 2 fuel oil. In Figure 68 data obtained at two inlet air temperature settings (600°F and 800°F) are shown for natural gas.

The NO_x concentration "hump," which had been observed in the liquid-fuel tests, was also found in the higher inlet air temperature tests; the "hump" was not observed at the lower inlet air temperature tests.

A subsequent test series was conducted to ascertain the influence of the gaseous fuel injection means on NO_x concentration. The initial tests had been carried out using a radial injector arrangement. An axial fuel injection arrangement (Scheme 5-12B, shown in Figure 69) was used during a second test series. Schematic diagrams of the two injection schemes are shown in Figure 70. Test data obtained during the second test series are shown in Figures 71 and 72. At lower values of overall equivalence ratio, the axial injection means was more effective than the radial in reducing the generation of NO_x at inlet air temperatures of both 600°F and 800°F. As the overall equivalence ratio was increased, the differences in NO_x concentration measured in the exhaust gas stream for both the radial and axial fuel injection arrangements were very small.



LB	AREF	L/D	VOLREF	ACDSUM
26.66	19.63	5.33	361.3	3.07

STATION	AX	ACD
A	2.924	0.450
B	2.924	0.0
C	20.619	0.162
D	19.625	1.247
E	19.625	0.119
F	19.625	0.974
G	19.625	0.119
X	113.040	0.0

Figure 69. Bench-Scale Combustor Scheme 5-12B

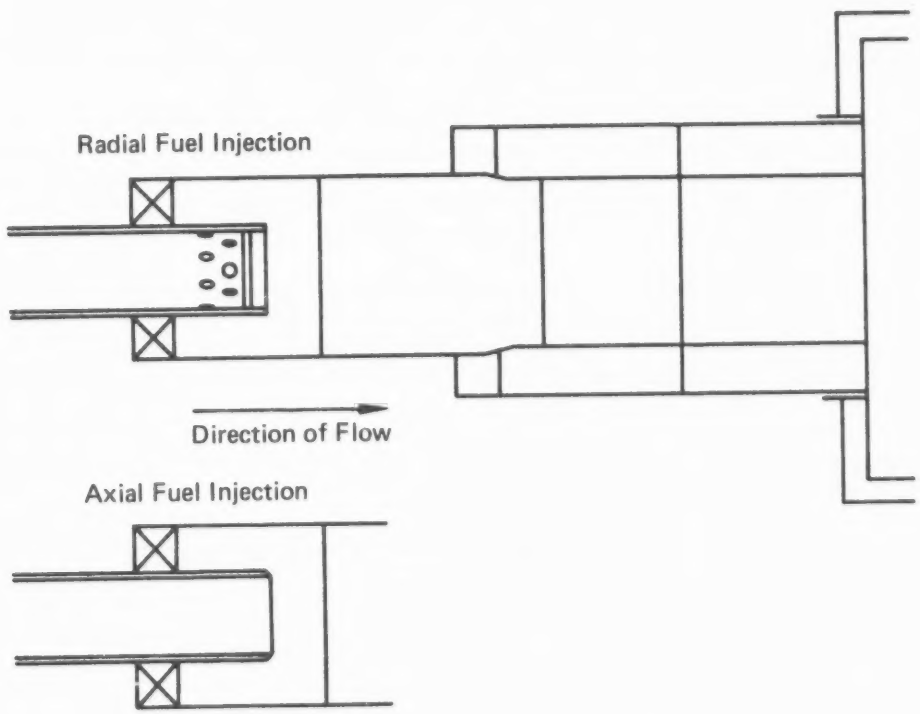


Figure 70. Schematic Diagrams of Natural Gas Fuel Injection Means

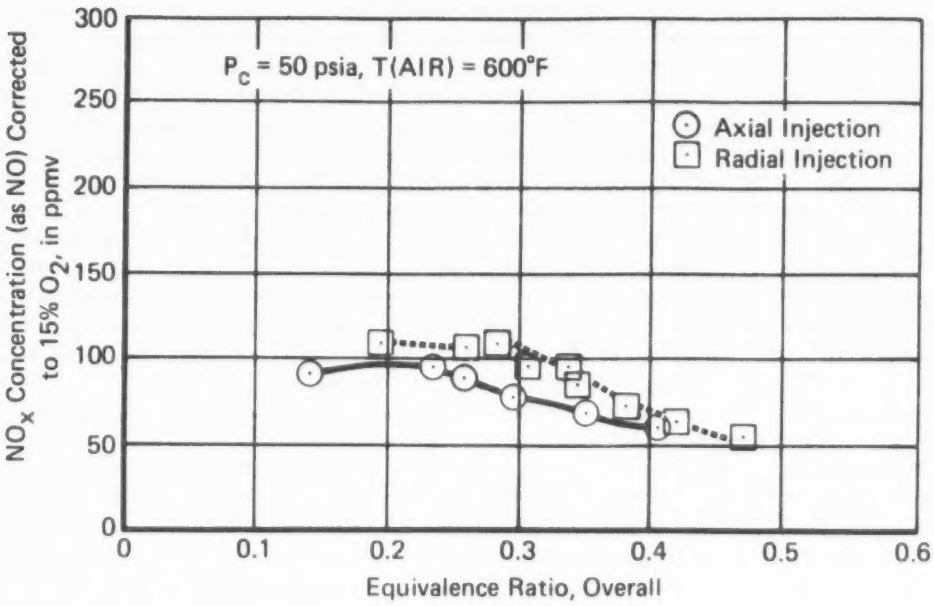


Figure 71. Variation in NO_x Concentration With Equivalence Ratio Fuel Injection Means for Natural Gas/Air

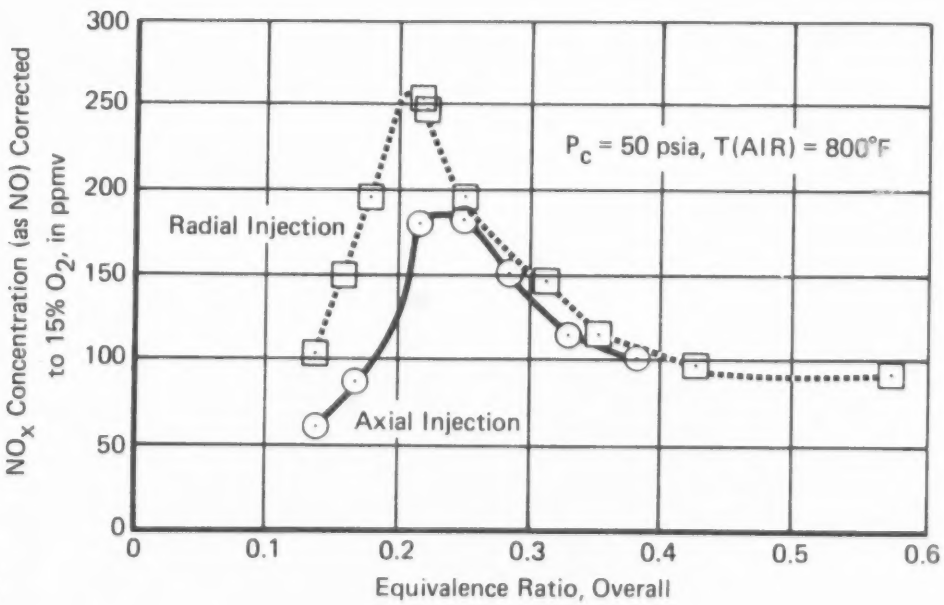
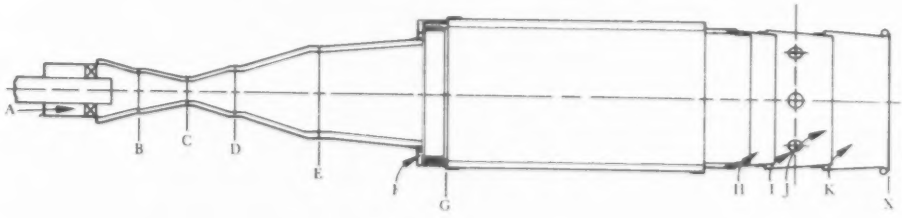


Figure 72. Variation in NO_x Concentration With Equivalence Ratio and Fuel Injection Means for Natural Gas/Air

The next test series was conducted firing natural gas to determine the effectiveness of the heat-removal concept in reducing NO_x production. The combustor configuration was altered to Scheme 5-13A (Figure 73) which provided a contraction in the premix tube (at point C in Figure 73) designed to prevent flame stabilization at the injector tube. Baseline tests were conducted initially without heat removal using Scheme 5-13A. Subsequent tests were conducted using dual heat exchanger modules in both a downstream and an upstream location as shown in Figures 74 and 75 (Schemes 5-14A and 5-15A). The data obtained in these tests are shown in Figures 76 and 77 for inlet-air temperatures of 600°F and 800°F, respectively. Heat removal was effective in reducing the production of NO_x when the heat exchanger was placed in the upstream, or near-dome, location. When the heat exchanger was placed further downstream in the burner, near the dilution region, there was generally no advantage except at high values of equivalence ratio at the high-inlet air temperature condition. In general, the upstream heat exchanger is believed to have reduced the reactant temperature in the NO_x formation region and, therefore, reduced the temperature contribution to the rate of formation of NO_x. The contribution of the downstream heat exchanger at the higher values of equivalence ratio for tests conducted at an inlet air temperature of 800°F is believed to have been essentially the same as the contribution of the heat exchanger in the upstream location during leaner operation. Reaction between the very fuel-rich mixture entering the dilution zone and the dilution air was influenced by the removal of heat in a critical NO_x formation region. In essence, at the higher values of equivalence ratio, the primary zone was shifted downstream to the dilution region and the heat removal concept functions as it had further upstream at leaner overall equivalence ratios. The reduction in NO_x concentration at the higher values of equivalence ratio for tests conducted with and without downstream removal of heat at an inlet air temperature of 800°F is shown in Figure 78.

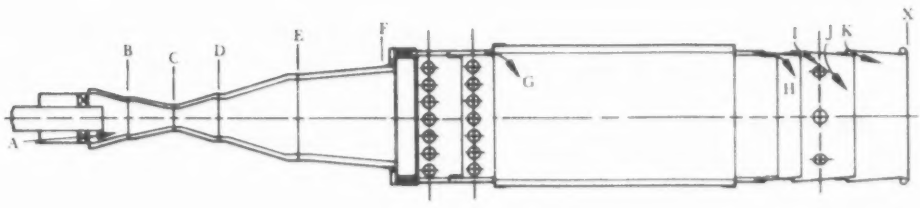


LB	AREF	L/D	VOLREF	ACDSUM
33.03	19.63	6.61	361.3	3.07

STATION	AX	ACD
A	2.924	0.450
B	1.495	0.0
C	0.533	0.0
D	2.035	0.0
E	7.589	0.0
F	9.882	0.0
G	20.619	0.102
H	19.625	1.247
I	19.625	0.119
J	19.625	0.974
K	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.75	1.00	0.0
BST2	8.00	0.95	0.0
BST3	14.00	2.00	0.0
BST4	26.90	2.00	0.0

Figure 73. Bench-Scale Combustor Scheme 5-13A

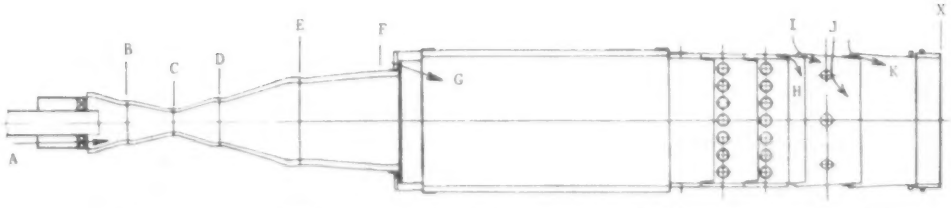


LB	AREF	L/D	VOLREF	ACOSUM
36.53	19.63	7.31	399.5	3.07

STATION	AX	ACD
A	2.924	0.450
B	1.495	0.0
C	0.533	0.0
D	2.035	0.0
E	7.389	0.0
F	9.882	0.0
G	20.619	0.162
H	19.625	1.247
I	19.625	0.119
J	19.625	0.974
K	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.00	1.00	330.0
BST2	7.50	1.20	0.0
BST3	13.50	2.00	330.0
BST4	21.50	2.81	30.0

Figure 74. Bench-Scale Combustor Scheme 5-14A



LB	AREF	L/D	VOLREF	ACOSUM
35.23	19.63	7.05	374.7	3.07

STATION	AX	ACD
A	2.924	0.450
B	1.495	0.0
C	0.533	0.0
D	2.035	0.0
E	7.389	0.0
F	9.882	0.0
G	20.619	0.162
H	19.625	1.247
I	19.625	0.119
J	19.625	0.974
K	19.625	0.119
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.00	1.00	330.0
BST2	7.50	1.20	0.0
BST3	13.50	2.00	330.0
BST4	18.00	2.81	30.0

Figure 75. Bench-Scale Combustor Scheme 5-15A

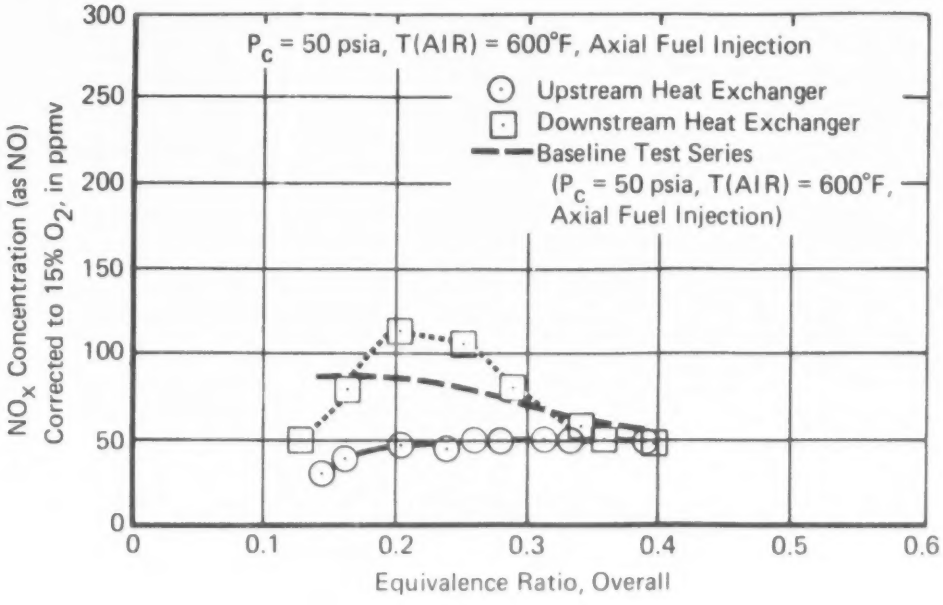


Figure 76. Comparison of Variations in NO_x Concentration With Equivalence Ratio and Heat Exchanger Location for Natural Gas/Air (pc = 50 psia, Tair = 600°F)

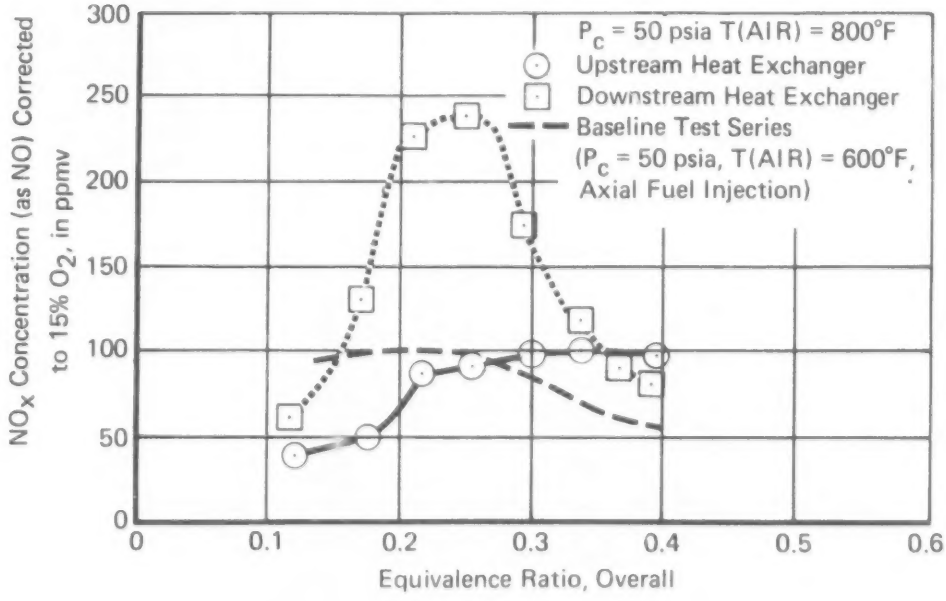


Figure 77. Comparison of Variations in NO_x Concentration With Equivalence Ratio and Heat Exchanger Location for Natural Gas (pc = 50 psia, Tair = 800°F)

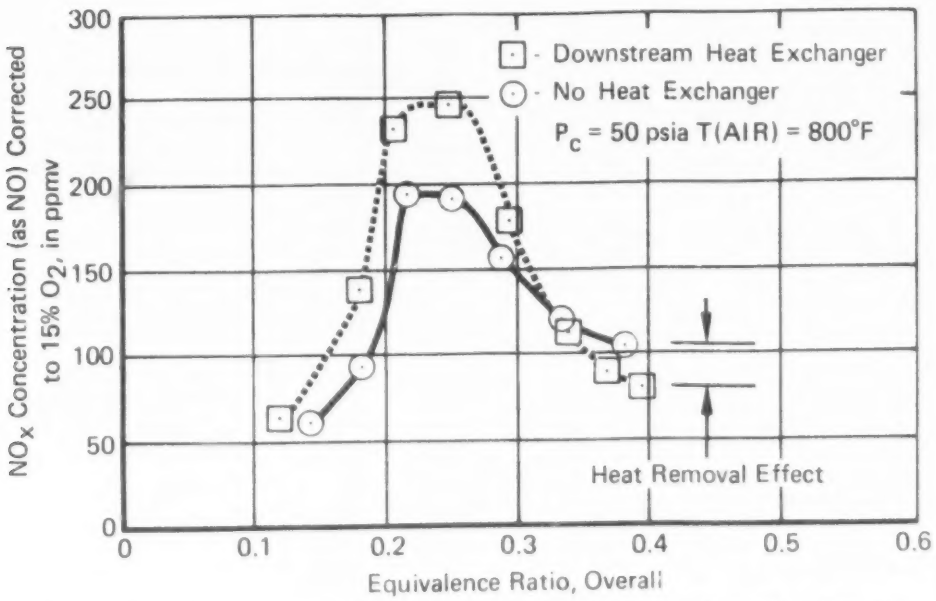


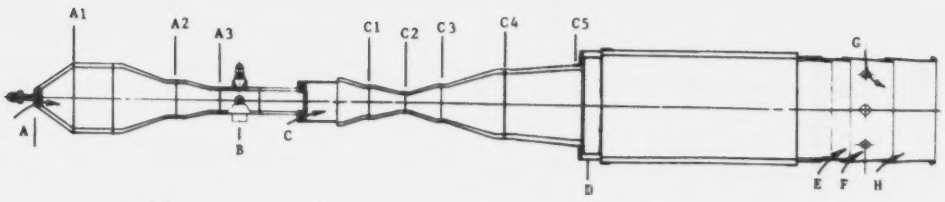
Figure 78. Comparison of Variations in NO_x Concentration With Equivalence Ratio With and Without Downstream Heat Removal (pc = 50 psia, Tair = 800°F)

Having established baseline results for the Heat Removal Concept using natural gas, the combustor was reconverted to liquid fuel operation, and tests were conducted firing No. 2 fuel oil and using four different configurations of the bench-scale hardware. Variations in the rate and location of heat removal were provided, as shown in Figures 79 through 82.

Thirty-three test points at rig pressures of 50, 100, 125, and 150 psia were obtained. In these tests the rate of heat removal was varied by mounting either two or four heat-exchanger modules (it had been determined previously that variations in heat exchanger water flow rate did not significantly effect the rate of heat transfer).

The variation in NO_x concentration with equivalence ratio and the relative rate of heat removal is shown in Figure 83, for both No. 2 fuel and natural gas (data previously shown). As expected, NO_x levels were higher with No. 2 fuel (because of imperfect fuel vaporization), and with the lower rate of heat removal (two heat exchanger modules). These data (along with subsequent pressure-parametric data) also show a tendency toward higher NO_x concentrations as pilot fuel flow was increased.

Parametric data showing the variation in NO_x concentrations with equivalence ratio and chamber pressure are shown in Figure 84. Although measured concentrations generally increased with increasing pressure, the data obtained at 125 psia were an exception, exhibiting higher concentrations than the data at 150 psia.

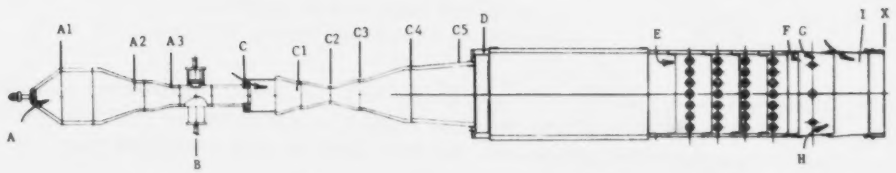


LB	AREF	L/D	VOLREF	ACDSUM
43.28	19.63	8.65	361.3	3.14

STATION	AX	ACD
A	0.0	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.501
C1	1.495	0.0
C2	0.533	0.0
C3	2.035	0.0
C4	7.389	0.0
C5	9.882	0.0
D	20.619	0.162
E	19.625	1.247
F	19.625	0.119
G	19.625	0.974
H	19.625	0.119

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.20	1.75	0.0
BST2	11.00	0.65	0.0
BST3	15.00	1.00	0.0
BST4	27.10	2.61	0.0

Figure 79. Bench-Scale Combustor Scheme 5-16A

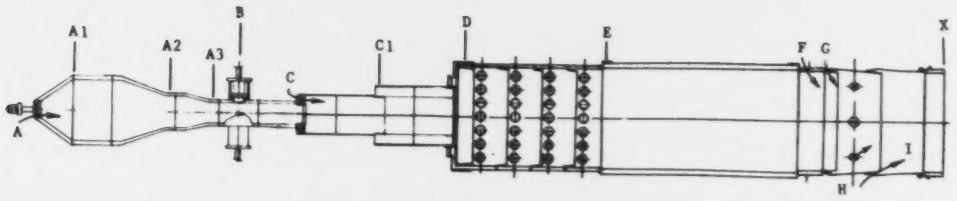


LB	AREF	L/D	VOLREF	ACDSUM
52.55	19.63	10.51	613.1	6.22

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	1.495	0.0
C2	0.533	0.0
C3	2.035	0.0
C4	7.389	0.0
C5	9.882	0.0
D	19.379	0.162
E	19.079	0.0
F	19.079	0.800
G	19.625	0.119
H	19.625	0.974
I	19.625	0.119
X	113.040	3.527

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	11.00	0.66	0.0
BST3	15.00	1.00	0.0
BST4	29.63	2.81	0.0

Figure 80. Bench-Scale Combustor Scheme 5-17A

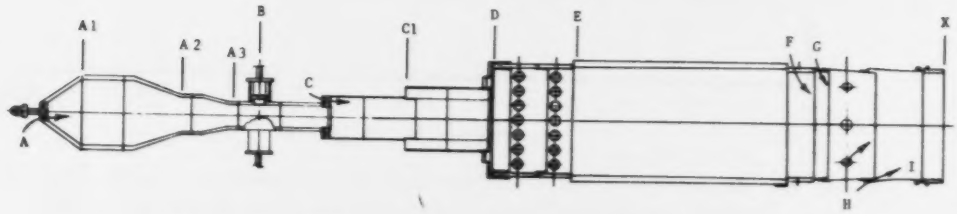


LB	AREF	L/D	VOLREF	ACDSUM
47.92	19.63	9.58	572.8	5.43

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	2.909	0.0
D	19.079	0.162
E	19.079	0.0
F	19.079	1.150
G	19.625	0.119
H	19.625	0.974
I	19.625	0.119
X	113.040	2.386

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	11.00	0.66	0.0
BST3	21.00	1.50	0.0
BST4	32.00	2.81	0.0

Figure 81. Bench-Scale Combustor Scheme 5-18A



LB	AREF	L/D	VOLREF	ACDSUM
44.42	19.63	8.88	505.9	5.75

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	2.909	0.0
D	19.079	0.162
E	19.079	0.0
F	19.079	1.150
G	19.625	0.119
H	19.625	0.974
I	19.625	0.119
X	113.040	2.711

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	11.00	0.66	0.0
BST3	21.00	1.50	0.0
BST4	28.50	2.81	0.0

Figure 82. Bench-Scale Combustor Scheme 5-19A

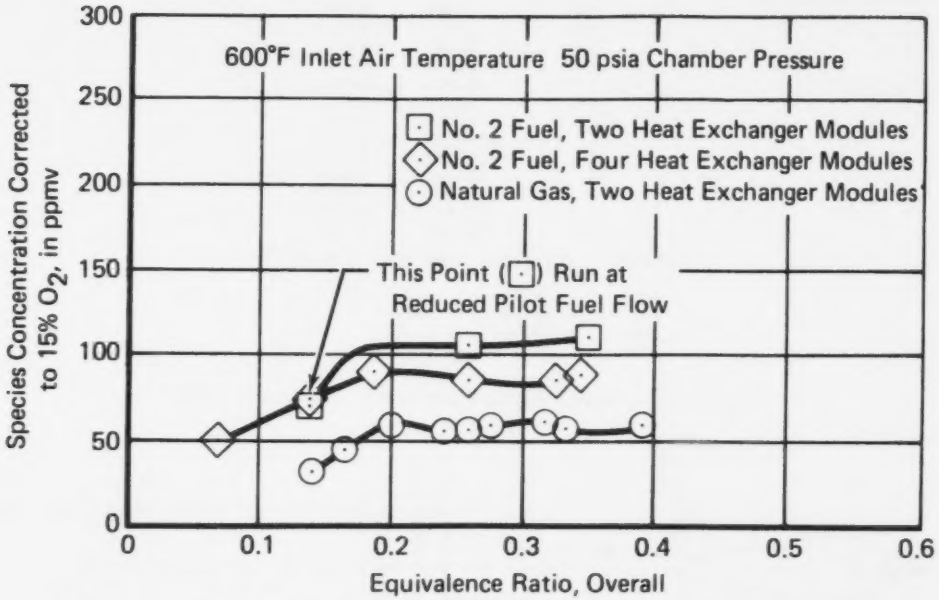


Figure 83. Variation in NO_x Concentration With Equivalence Ratio, Type Fuel, and Rate of Heat-Removal for the Heat-Removal Concept (No. 5)

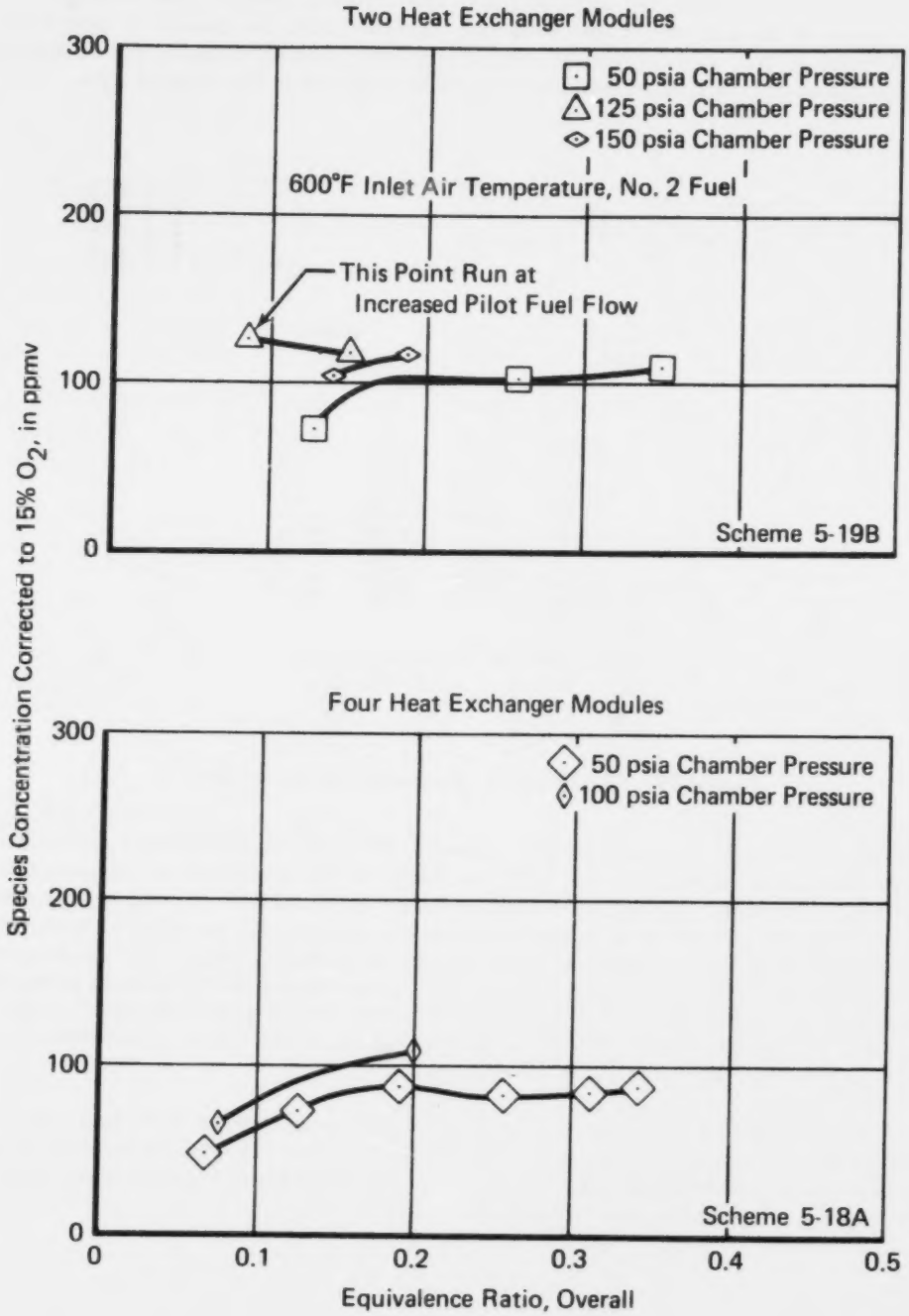
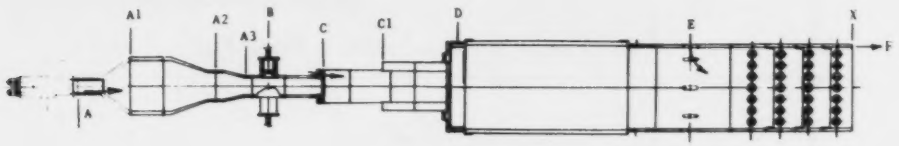


Figure 84. Comparison of Variation in NO_x Concentration With Equivalence Ratio and Chamber Pressure for Two Rates of Heat Removal in Concept No. 5 (Heat-Removal)

Toward the end of the testing of Concept No. 5, another arrangement of the burner component modules was evaluated. In Scheme 5-20A, shown in Figure 85, heat exchanger modules were positioned downstream of the penetration air jets in the dilution zone, in an attempt to achieve a lower flame temperature in the burnout process that occurred there. In the dilution zone, fuel-rich gases from the primary zone were mixed with excess air and reacted to completion. Previous tests had indicated that this diffusion-burning process might be a principal source of thermal NO_x. Other tests had indicated that the removal of heat from a burner operating at lean to stoichiometric equivalence ratios can significantly reduce thermal NO_x. It was reasoned that similar reductions might be achieved in the dilution zone.



LB	AREF	L/D	VOLREF	ACDSUM
46.27	19.63	9.25	476.4	5.15

STATION	AX	ACD	PHI	MACUM
A	0.031	0.024	1.562	0.463
A1	7.389	0.0	1.562	0.463
A2	2.035	0.0	1.562	0.463
A3	0.864	0.0	1.562	0.463
B	0.864	0.0	70.992	0.463
C	0.864	0.500	3.231	10.168
C1	2.909	0.0	3.231	10.168
D	19.079	0.162	2.468	13.313
E	19.079	1.251	0.874	37.595
F	19.079	0.800	0.618	53.124
X	113.040	2.415	0.329	100.000

MEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	14.00	0.66	0.0
BST3	17.50	1.00	0.0
BST4	25.00	2.81	0.0

Figure 85. Bench-Scale Combustor Scheme 5-20A

The results of tests conducted of this version of the heat-removal concept are shown in Figure 86. The curves for NO_x, CO, and UHC are similar to those obtained in previous tests of the heat removal concept: (1) NO_x concentration levels increased with increasing equivalence ratio up to the point that the local mixture ratio in the primary zone exceeded stoichiometric conditions, then declined as conditions there became progressively richer (this produces the familiar "hump" in the NO_x curve); (2) CO and UHC concentration levels declined as the NO_x curve approaches its peak. However, a significant departure from the previous results is seen in the fact that CO concentration levels were sharply higher at the higher equivalence ratios, giving the CO curve a characteristic "bucket shape."

Previously, in tests of the heat-removal concept, CO concentration levels had continued to decline as overall equivalence ratio was increased. In this case, however, the removal of heat during the burnout process apparently caused a large portion of the CO coming down from the primary zone into the dilution zone to be quenched.

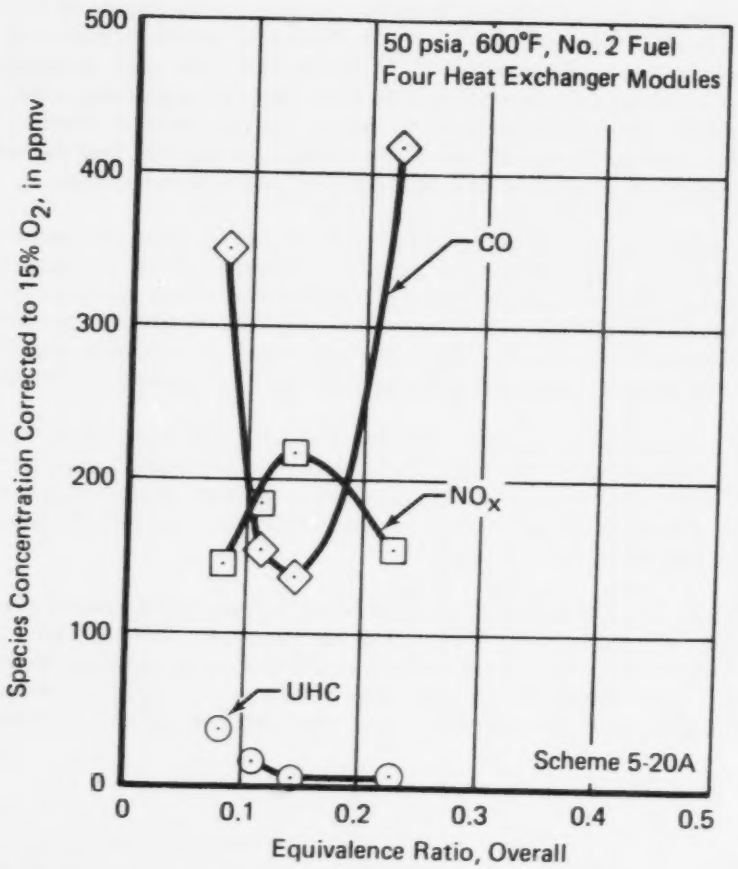


Figure 86. Variation in Species Concentration With Equivalence Ratio for Concept No. 5 (Heat-Removal)

One further series of tests was conducted in which the heat exchanger modules (4 units) were positioned downstream of the dilution air jets. The initial results obtained using this arrangement (Scheme 5-20A) had indicated that quenching of CO (which ordinarily would be consumed in the dilution zone) had taken place due to the presence of the heat exchanger modules in the aft section of the burner. It had been postulated that a more gradual rate of addition of dilution airflow might help avoid the quenching of CO. Accordingly, the burner configuration was changed to include round dilution air holes (see Figure 87) in place of the rectangular slots that had been used previously. It was reasoned that the penetration of the round holes would be diminished, resulting in a more gradual dilution process. The test results obtained did not support this hypothesis. As may be seen in Figure 88, both CO concentrations and UHC concentrations were higher for the burner using round holes. Conversely, NO_x concentrations were lower. It was conjectured that the interaction between dilution air jets and the cooled tubes of the heat exchanger modules might be more complex than originally imagined. If, for example, dilution air jets happen to impinge directly upon the heat exchanger tubes in one configuration but not in another, then local regions of excessive quenching may exist, with resultant high concentrations of CO and UHC.

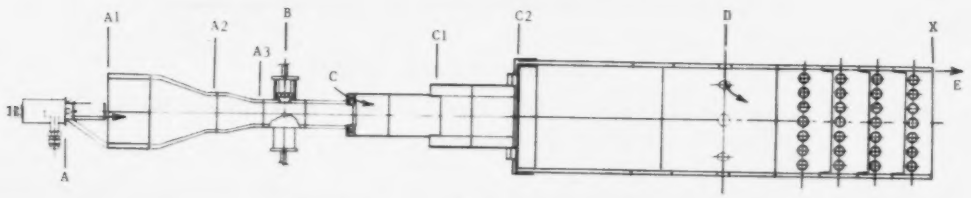
Two final configurations using water as the coolant fluid were evaluated. As shown in Figures 89 and 90, these Schemes (5-22A and 5-23A) were essentially the same as Scheme 5-18A. Data generated for Schemes 5-22A and 5-23A were generally consistent with those previously generated, and are tabulated in Appendix A.

The use of air rather than water as the coolant in the heat exchanger tubes was evaluated in three burner schemes. The configuration of the bench-scale burner hardware used to accommodate air was necessarily different from the previous configurations used for water. A comparison of the two basic designs may be seen in Figures 82 and 91. In Figure 82, the basic configuration used for water (Scheme 5-19A) is represented. Two heat exchanger modules (each consisting of an array of seven tubes mounted in a plane perpendicular to the axis of the burner), were located in the primary zone of the burner. The burner had a ceramic liner, and a piloted prevaporizer module for liquid fuel. Water passing through the heat exchanger tubes was dumped outside the rig, resulting in a net heat loss to the burner system.

The basic configuration for air is shown in Figure 91 and 92. Heat exchanger tubes were located in six consecutive planes (five tubes per plane) perpendicular to the burner axis. The airflow passing through the tubes was collected in a shroud and conducted to the aft section of the burner where it was introduced as dilution air. All the dilution airflow passed through the heat exchanger tubes in this manner. The tubes were sized to remove a quantity of heat roughly equal to the amount removed by the water-fed heat exchanger modules in Figure 82.

The air-fed configurations differed from the water-fed configuration in two main respects: first, the tubes in Figure 53 were positioned farther downstream (causing heat to be removed at an "intermediate zone" location rather than a primary zone location); and second, the heat removed was reintroduced into the burner rather than dumped overboard, with no resultant net heat loss to the burner system.

The test results obtained with Scheme 5-24A and Scheme 5-25A (essentially the same) are shown in Figure 93. Curves for NO_x and CO are presented. The apparent data scatter among the lower equivalence ratio points was the result of a minor variation in primary zone cooling airflow that existed between the two schemes. The two reference curves included are for NO_x as generated in previous tests of the basic water-fed heat-removal configuration.



LB	AREF	L/D	VOLREF	ACDSUM
41.50	19.63	8.30	382.8	3.28

STATION	AX	ACD
A	0.031	0.023
A1	1.389	0.0
A2	2.038	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.864	0.500
C1	2.409	0.0
C2	19.079	0.0
D	19.079	0.974
E	19.079	0.800
X	113.040	2.981

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	14.00	0.66	0.0
BST3	17.50	1.00	0.0
BST4	25.00	2.81	0.0

Figure 87. Bench-Scale Combustor Scheme 5-21A

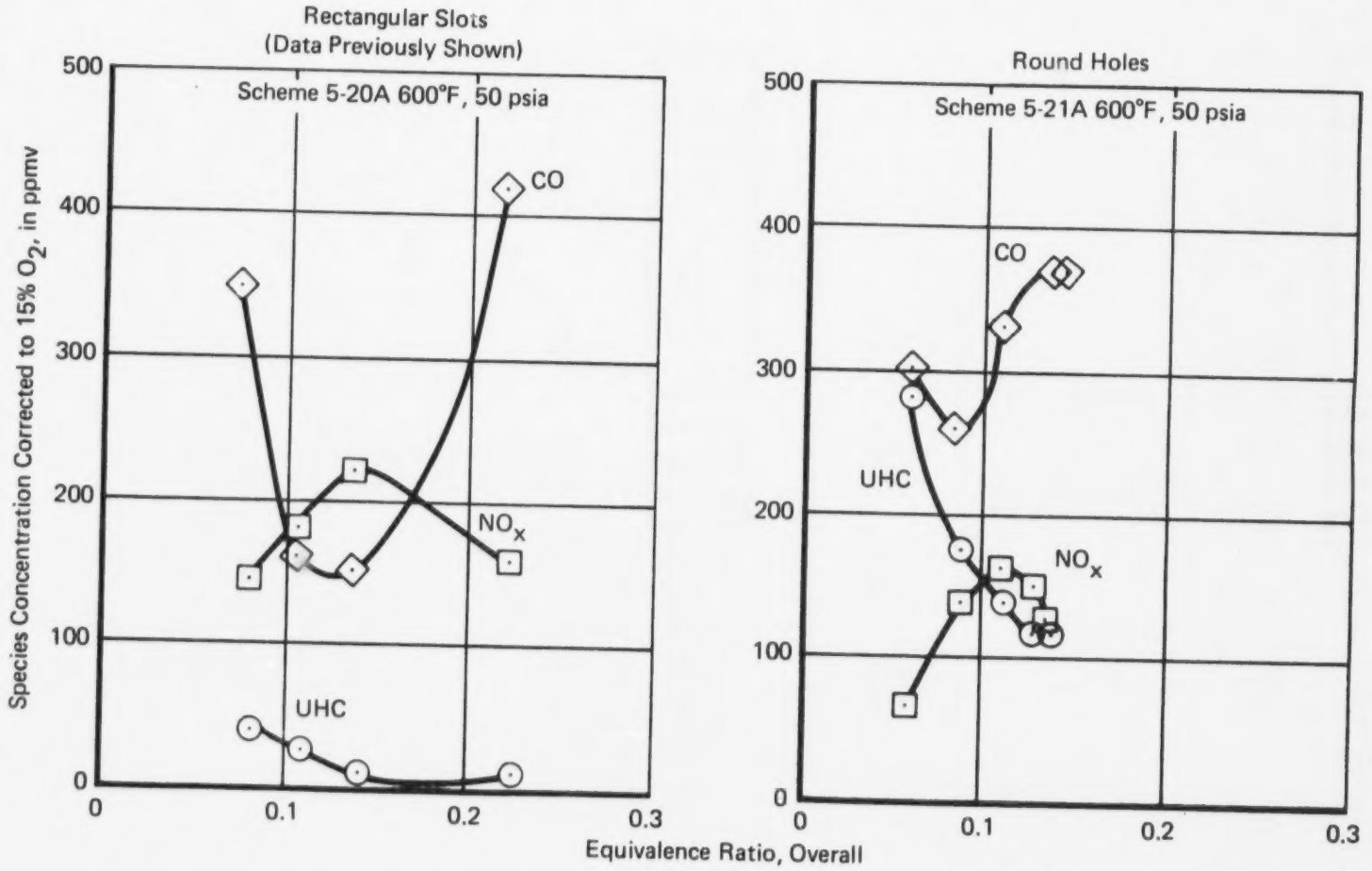
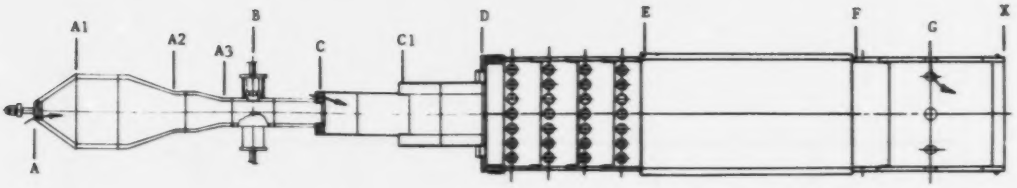


Figure 88. Comparison of Variation in Emission Concentrations With Equivalence Ratio for Two Dilution Air Hole Shapes in Concept No. 5 (Heat-Removal) (Four Heat Exchange Modules, Downstream of Dilution Air Jets)

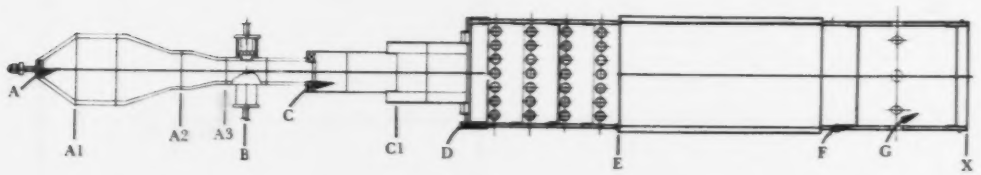


LB	AREF	L/D	VOLREF	ACDSUM
46.80	19.63	9.36	496.6	5.73

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.864	0.500
C1	2.909	0.0
D	19.079	0.800
E	19.079	0.0
F	19.079	1.187
G	19.079	0.974
X	113.040	2.250

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	12.00	0.66	0.0
BST3	20.00	1.50	0.0
BST4	31.50	2.81	0.0

Figure 89. Bench-Scale Combustor Scheme 5-22A

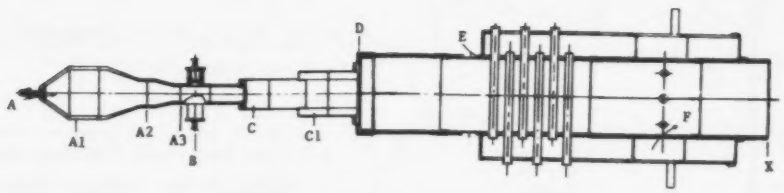


Lb	AREF	L/D	VOLREF	ACDSUM
46.80	19.63	9.36	496.6	5.53

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.864	0.500
C1	2.909	0.0
D	19.079	0.162
E	19.079	0.0
F	19.079	1.187
G	19.079	0.974
X	113.040	2.685

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	12.00	0.66	0.0
BST3	20.00	1.50	0.0
BST4	31.50	2.81	0.0

Figure 90. Bench-Scale Combustor Scheme 5-23A

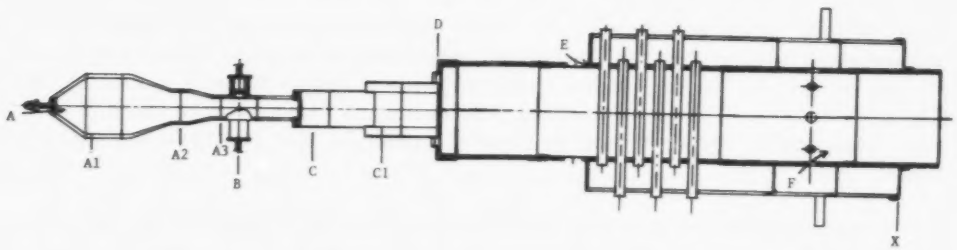


LB	AREF	L/D	VOLREF	ACDSUM
48.25	19.63	9.65	542.3	4.96

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.864	0.500
C1	2.909	0.0
D	19.079	0.0
E	19.079	0.705
F	19.079	1.257
X	113.040	2.479

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	28.60	3.41	270.0
BST2	7.00	0.95	0.0
BST3	12.50	0.66	0.0
BST4	20.00	1.50	0.0

Figure 91. Bench-Scale Combustor Scheme 5-24A



LB	AREF	L/D	VOLREF	ACDSUM
48.25	19.63	9.65	542.3	4.50

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.664	0.500
C1	2.909	0.0
D	19.079	0.705
E	19.079	0.0
F	19.079	1.257
X	113.040	2.024

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	28.60	3.41	270.0
BST2	7.00	0.95	0.0
BST3	12.50	0.66	0.0
BST4	20.00	1.50	0.0

Figure 92. Bench-Scale Combustor Scheme 5-25A

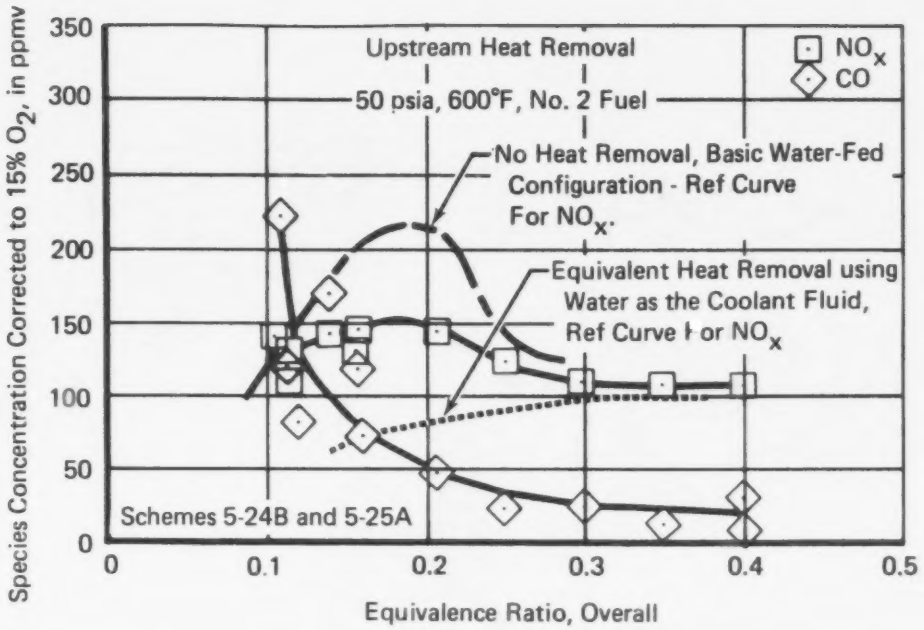
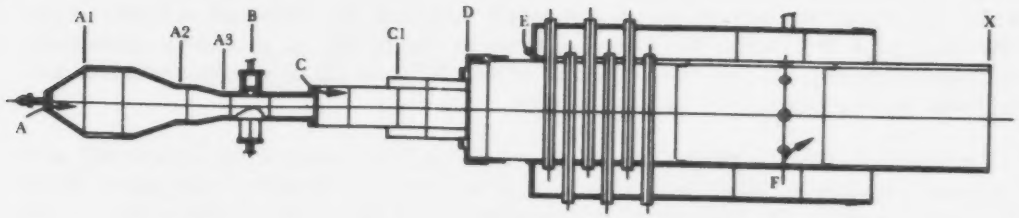


Figure 93. Variation in Species Concentration With Equivalence Ratio for Concept No. 5 — Heat Removal Using Air as the Coolant Fluid

The NO_x data for the air-fed configuration fell midway between the two reference curves. This result suggested that some degree of NO_x suppression was achieved relative to the no-heat-removal case, but that the reduction was not as pronounced as that achieved using water as the coolant fluid. There are two factors that may have contributed to this result: (1) the water-fed heat exchanger modules may have been more effective in reducing the peak flame temperature because they were located in the primary zone rather than the intermediate zone of the burner; (2) in the air-fed configuration the reintroduction of coolant airflow (carrying with it the full complement of the heat previously removed) into the dilution zone may have compromised any reduction in flame temperature that had been achieved in the intermediate zone.

Further evaluation of the use of air rather than water as the coolant was carried out using Scheme 5-26A (Figure 94) in which the heat exchanger tubes were moved to an upstream location comparable to that which had been used in previous water-fed configurations. Results of tests conducted with Scheme 5-26A indicated that significant reductions in the NO_x concentration levels were not achieved.

From the experiments conducted during the evaluation of Concept No. 5, Heat Removal, it was concluded that the removal of heat from the combustor in quantities that could be achieved utilizing the practical devices selected, did not produce reductions in NO_x great enough to meet the program goals. It was shown that heat removal did effect NO_x, but that significant improvements in the heat exchangers used would be necessary to realize any further potential gains. It was also demonstrated that the implementation of improved techniques for fuel prevaporization resulted in modest reductions in NO_x for this concept. Concept No. 5 was eventually retired.



LB	AREF	L/D	VOLREF	ACDSUM
47.22	19.63	9.44	522.0	5.92

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	0.864	0.500
C1	2.909	0.0
D	19.079	0.0
E	19.079	0.705
F	19.079	1.257
X	113.040	3.440

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.75	0.0
BST3	23.70	2.66	0.0

Figure 94. Bench-Scale Combustor Scheme 5-26A

3.3.6 Evaluation of Concept No. 6 — Quench Reheat

Concept No. 6, Quench Reheat, was one of the five concepts initially labeled as a primary concept and designated for definitive testing. This concept embodied introducing a reasonably homogeneous fuel-air mixture into the main burning zone. This mixture was to be fuel-rich within the main burning volume. The main (primary) zone was terminated by a very rapid quenching process to an extremely lean fuel-air ratio. While this quenching would freeze thermal NO_x formation, excessive quantities of CO would be formed. In a reheat zone, effluent from a small pilot burner would raise the temperature of the quenched products from the main zone to a temperature which would be high enough to efficiently consume CO, while at the same time, be low enough to preclude the formation of appreciable thermal NO_x in the reheat zone.

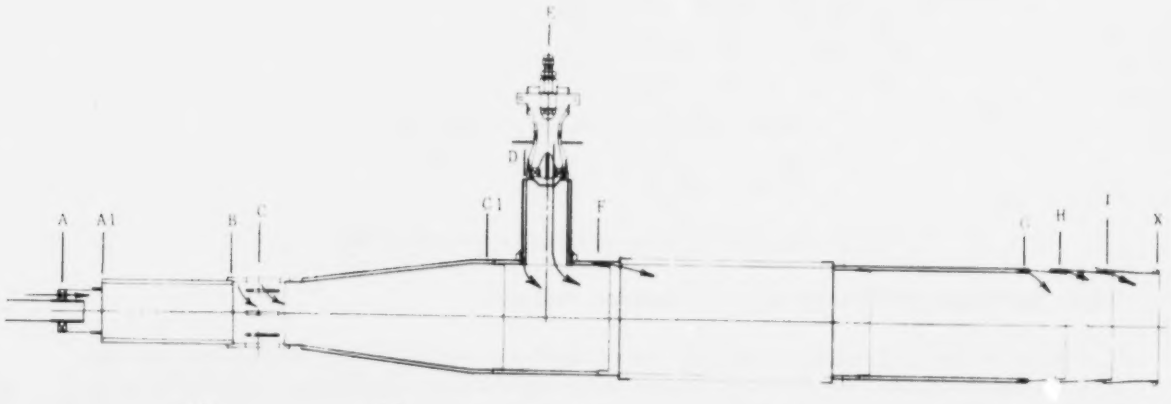
A brief series of tests, consisting of the evaluation of five variations of the combustor hardware, was carried out to determine the NO_x reduction capability of the Quench Reheat concept. These tests are described in the following paragraphs.

The initial configuration of the quench reheat combustor is depicted in Figure 95. Representative experimental hardware is shown in Figure 96. Subsequent tests of the concept were conducted using Schemes 6-2A through 6-5A, shown in Figures 97 through 100. These configurations represented minor variations in the combustor airflow distribution and in the method of primary zone fuel injection; the variations did not significantly alter the emission characteristics of the combustor.

Figure 101 contains representative data showing the variation in NO_x and CO concentrations with overall equivalence ratio for tests conducted at a chamber pressure of 50 psia and an inlet-air temperature of 600°F. The fuel burned in the primary combustor was natural gas; the fuel burned in the reheat burner was No. 2 fuel oil. Results indicate that the reheat configuration (single side entry burner) did not completely consume the CO that was produced

in the quick quench zone of the mainstage burner. The side-mounted reheat burner was observed to produce a single jet of flame that penetrated to the central axis of the main burner that did not visibly mix out in the 15-inch length provided. An important sidelight of the results obtained with Concept No. 6 is also shown in Figure 101. At an overall equivalence ratio of approximately 0.11, low concentrations of both NO_x and CO were measured simultaneously (both near 50 ppmv, corrected to 15% O_2).

The identification of a single operating point having low concentrations of both NO_x and CO exhaust constituents, while unexpected, served as a basis for further investigation. While more closely observing the basic emission characteristics of this concept (Figure 101), it was noticed that the NO_x concentration tended to decline with equivalence ratio to an apparent minimum which was low enough to meet the program goal. At the same time, CO went through a peak and then rapidly declined as the equivalence ratio within the reheat region increased. It was apparent that by carefully controlling the stoichiometry of both the main combustion zone and the reheat zone concurrently, low values of both NO_x and CO could be obtained, without the use of the reheat pilot burner.

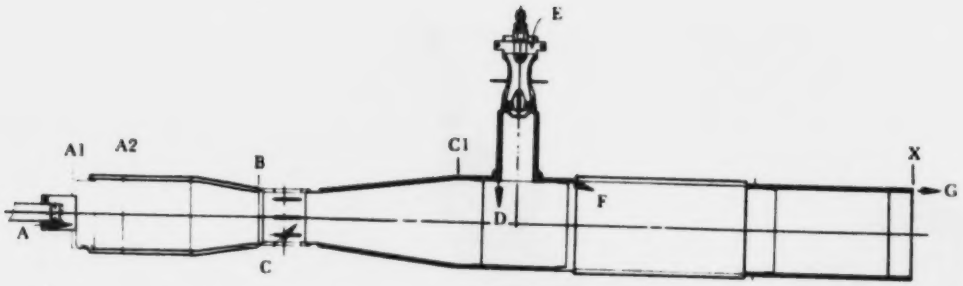


STATION	AX	ACC
A	2.924	0.501
A1	6.176	0.0
B	6.176	0.101
C	6.484	1.728
C1	19.079	0.0
D	19.079	0.071
E	19.079	0.148
F	19.079	0.677
G	19.079	1.665
H	19.079	0.119
I	19.079	0.119
X	113.043	1.373

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	9.25	1.63	0.0
BST2	11.25	1.50	0.0
BST3	22.70	0.75	0.0
BST4	36.20	2.66	0.0

Figure 95. Bench-Scale Combustor Scheme 6-1A

Figure 96. Experimental Hardware Used in the Evaluation of Concept No. 6 — Quench Reheat

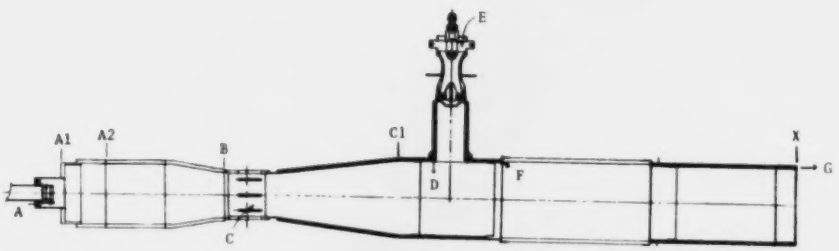


LB	AREF	L/D	VOLREF	ACDSUM
51.50	19.63	10.30	842.7	6.50

STATION	AX	ACD
A	2.924	0.501
A1	12.560	0.0
A2	12.560	0.0
B	6.484	0.0
C	6.484	1.726
C1	19.079	0.0
D	19.079	0.071
E	19.079	0.148
F	19.079	0.677
G	19.079	1.665
X	113.040	1.712

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	2.25	0.0
BST2	13.25	1.50	0.0
BST3	24.70	6.75	0.0
BST4	38.20	2.66	0.0

Figure 97. Bench-Scale Combustor Scheme 6-2A

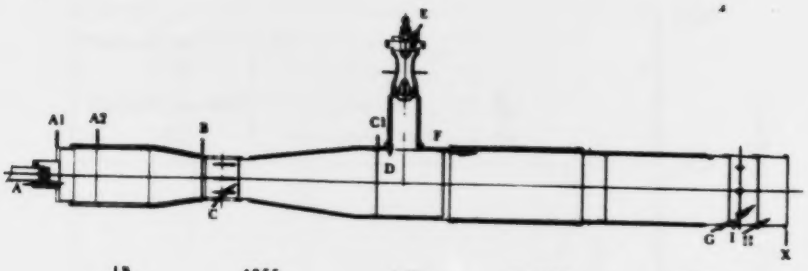


LB	AREF	L/D	VOLREF	ACDSUM
51.50	19.63	10.30	842.7	6.50

STATION	AX	ACD
A	2.924	0.501
A1	12.560	0.0
A2	12.560	0.0
B	6.484	0.0
C	6.484	1.726
C1	19.079	0.0
D	19.079	0.071
E	19.079	0.148
F	19.079	0.677
G	19.079	0.150
X	113.040	3.227

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	2.25	0.0
BST2	13.25	1.50	0.0
BST3	24.70	6.75	0.0
BST4	38.20	2.66	0.0

Figure 98. Bench-Scale Combustor Scheme 6-3A

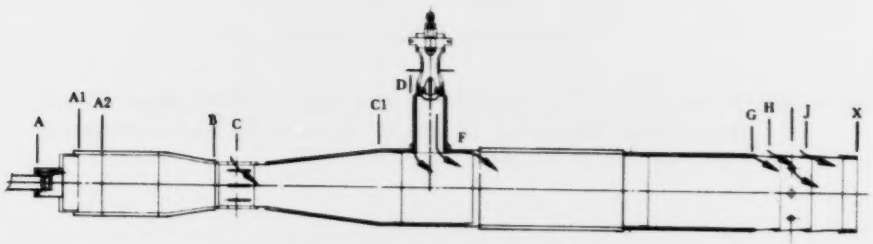


LB	AREF	L/D	VOLREF	ACDSUM
56.27	19.63	11.25	940.9	6.53

STATION	XX	ACD
A	2.924	0.205
A1	12.560	0.0
A2	12.560	0.0
B	6.484	0.0
C	6.484	1.381
C1	19.079	0.0
D	19.079	0.071
E	19.079	0.148
F	19.079	0.061
G	19.079	0.150
H	19.625	0.119
I	19.625	0.548
J	19.625	0.119
X	113.040	3.724

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.30	2.25	0.0
BST2	18.00	1.50	0.0
BST3	27.15	0.75	0.0
BST4	42.15	2.66	0.0

Figure 99. Bench-Scale Combustor Scheme 6-4A



LB	AREF	L/D	VOLREF	ACDSUM
57.27	19.63	11.45	940.9	4.30

STATION	XX	ACD
A	2.924	0.205
A1	12.560	0.0
A2	12.560	0.0
B	6.484	0.0
C	6.484	1.381
C1	19.079	0.0
D	19.079	0.071
E	19.079	0.148
F	19.079	0.061
G	19.079	0.150
H	19.625	0.119
I	19.625	0.548
J	19.625	0.119
X	113.040	1.499

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	2.25	0.0
BST2	18.00	1.50	0.0
BST3	27.15	0.75	0.0
BST4	42.15	2.66	0.0

Figure 100. Bench-Scale Combustor Scheme 6-5A

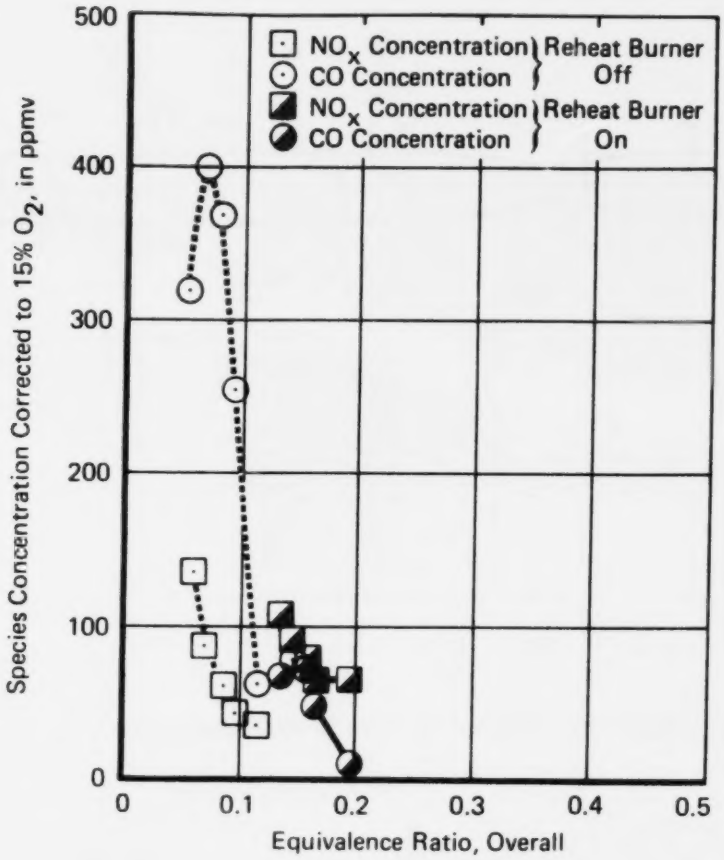


Figure 101. Variation in NO_x and CO Concentrations With Equivalence Ratio and Operating Mode for Quench-Reheat Combustor Concept (PC = 50 psia, T_{air} = 600°F)

In conclusion the results of the Quench Reheat concept were found to be very encouraging in that low concentrations of both NO_x and CO were attained at a single operating condition. These very low concentrations were apparently an outcome of the rapid quenching of fuel-rich primary zone products of combustion made possible by the use of a "quick-quench" module. The original concept had called for the use of a "reheat combustor" in the secondary zone to promote the burnout of excess CO that might have been kinetically frozen in passing through the quick-quench module. Although high concentration levels of CO were formed in the quick-quench module over most of the range of operation of the combustor, use of the reheat combustor was found to be counterproductive: reductions in CO were accompanied by increased NO_x concentration levels. There remained, however, a single operating condition at which both NO_x and CO concentration levels were low without use of the reheat combustor. These test results indicated that the reheat combustor should be eliminated, and that further evaluation of a modified version of the original concept should be undertaken. This ultimately led to the identification of Concept No. 29, Rich Burn/Quick Quench, which successfully demonstrated superior emission reduction capabilities and was eventually chosen as the single concept to be implemented to full-scale hardware.

3.3.7 Evaluation of Concept No. 7 — Staged Centertube Burner

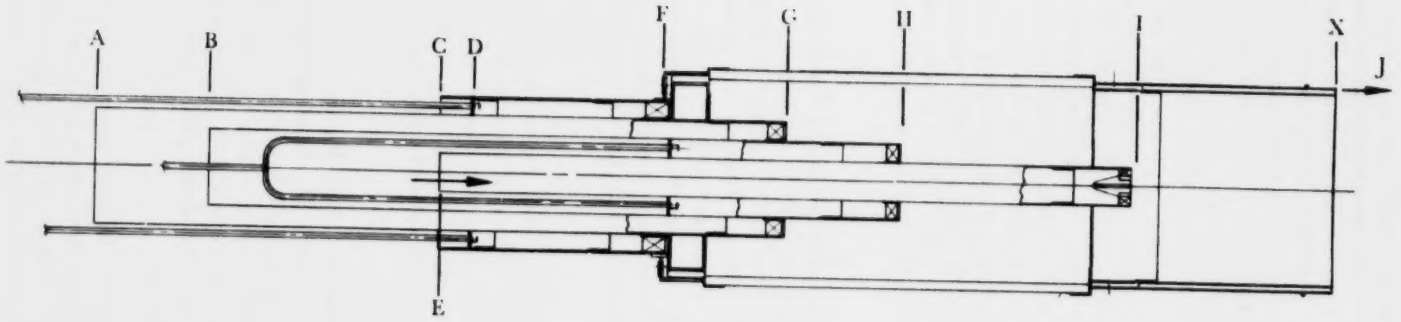
The staged centertube combustor incorporates swirl mixing and swirl burning as principal design concepts. Adoption of this basic combustor arrangement as a design concept in itself provided the opportunity to construct a versatile test piece to evaluate several major design concepts in combination with swirl mixing and swirl burning. The basic configuration consisted of a centertube structure with four concentric tubes, and a double-wall, convectively cooled liner. Each of the four tubes supplied air (or a fuel-air mixture) to a particular zone of the combustor. Swirl was imparted to the flow in each zone by vanes in the concentric tubes. In the first zone, swirling flow provided the principal means of flame stabilization. Although no region of appreciable reverse flow was set up because of the centertube structure, the swirl vanes established a centrifugal force field that served to move the denser gases (cooler, unburned) radially outward, and the less dense gases (hot, burning) radially inward. The interactive movements of these gases caused an increase in turbulence and a higher turbulent flamespeed, making it possible to establish a stable flamefront with minimum dependence on regions of recirculating flow that may contribute to thermal NO_x formation. In the second zone, dilution airflow was added through swirl vanes, again setting up a centrifugal force field. The dilution air (colder) entering this zone from the inner wall was forced radially outward, mixing rapidly with the burned gases from the first zone. This swirl mixing process was duplicated in the third and fourth zones where (colder) air and fuel-air mixture were introduced into the burned gases from the centertube.

The evaluation of this concept was initiated using the configuration shown in Figure 102: a four-zone arrangement of the burner hardware with movable concentric centertubes. A photograph of the experimental hardware is shown in Figure 103. Fuel was introduced into the first (outer-most) and third tubes; the second and fourth tubes contained air alone. Equivalence ratios in the first and third zones were 0.5 at the design point fuel-air ratio of 0.020. No exhaust emission data were obtained with the configuration shown. Flashback was encountered in the outer premixing tube upon initial light off, resulting in destruction of the swirler. The cause of this occurrence was found to have been an unacceptably low velocity (less than 50 fps) in the premixing passage.

To correct the flashback problem, smaller premixing passages (with higher velocities) were decided upon. A second configuration (Figure 104) was assembled in which only the two innermost centertubes of the previous arrangement were retained. Fuel was introduced into both tubes at mixture velocities approaching 200 fps. Equivalence ratios in both tubes were 0.5 at the design point overall fuel-air ratio of 0.020. The centertube was movable, and could be actuated manually during testing.

Extensive testing of the basic lean-front-end configuration shown in Figure 104 was carried out; a total of six configuration changes (Schemes 7-2A through 7-7A, shown in Figures 104 through 109) representing only minor variations in the basic arrangement were made. The test results were consistently encouraging. NO_x concentration levels generally were found to be very responsive to changes in the burner overall equivalence ratio, providing evidence of thorough prevaporization and premixing. At low values of overall equivalence ratio, very low NO_x concentrations were measured; CO concentrations were also low.

In the tests conducted, the effects of fuel staging, centertube insertion depth, inlet air pressure and temperature, liner pressure loss, and ceramic vs metal liners were all evaluated. The data generated in these tests are presented in Figures 110 through 113. Data generally representative of the successful lean-front-end configuration are shown in Figure 110. In these tests fuel was introduced into the outer premixing passage only. The NO_x concentrations measured at overall equivalence ratios in the immediate vicinity of 0.2 were very low (e.g., 25 ppmv, corrected to 15% O_2). CO concentrations were also low (e.g., 20 ppmv corrected to 15% O_2).



LB	AREF	L/D	VOLREF	ACDSUM
33.27	19.63	6.65	339.0	4.40

STATION	AX	ACD
A	0.0	0.0
B	0.0	0.0
C	0.406	0.406
D	0.0	0.0
E	0.0	0.0
F	0.0	0.0
G	0.299	0.299
H	0.874	0.874
I	0.210	0.210
J	19.079	1.187
X	113.040	1.420

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.50	0.0
BST2	13.00	2.00	0.0
BST3	18.00	2.61	0.0

Figure 102. Bench-Scale Combustor Scheme 7-1A

Figure 103. Bench-Scale Hardware Used in the Evaluation of Concept No. 7, Staged Centertube Combustor

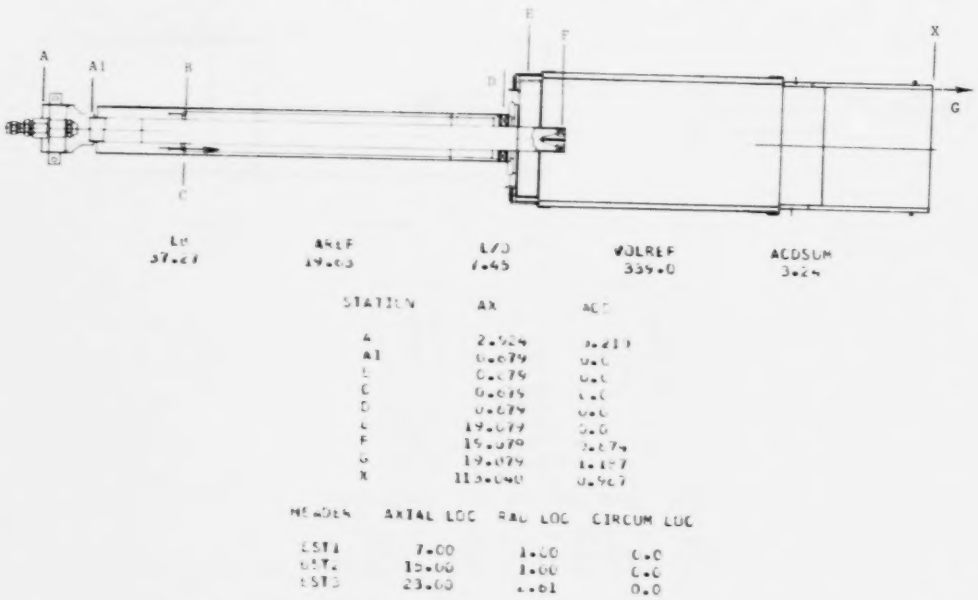
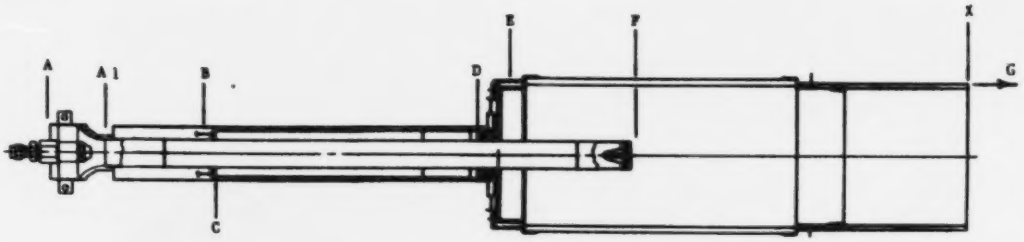


Figure 104. Bench-Scale Combustor Scheme 7-2A

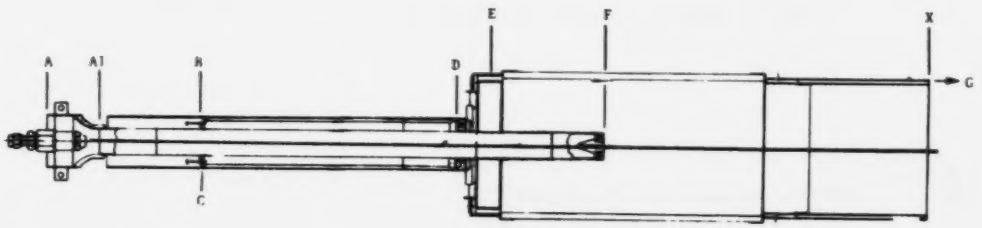


LB	AREF	L/D	VOLREF	ACDSUM
33.47	19.63	6.69	339.0	3.34

STATION	AX	ACD
A	2.924	0.210
A1	0.679	0.0
B	0.679	0.0
C	0.679	0.0
D	0.679	3.0
E	19.079	0.0
F	19.079	0.874
G	19.079	1.187
X	113.040	1.066

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.20	1.00	0.0
BST2	11.20	1.00	0.0
BST4	19.20	2.61	0.0

Figure 105. Bench-Scale Combustor Scheme 7-3A

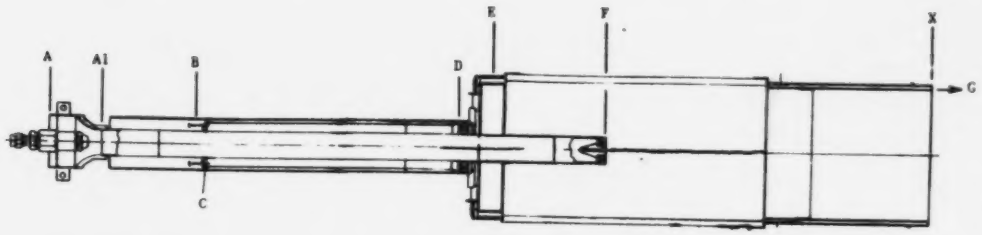


LB	AREF	L/D	VOLREF	ACDSUM
33.47	19.63	6.69	339.0	3.07

STATION	AX	ACD
A	2.924	0.210
A1	0.679	0.0
B	2.036	0.0
C	0.0	0.0
D	0.874	0.0
E	19.079	0.0
F	19.079	0.874
G	19.079	1.187
X	113.040	0.796

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.20	1.00	0.0
BST2	11.20	1.00	0.0
BST4	19.20	2.61	0.0

Figure 106. Bench-Scale Combustor Scheme 7-4A

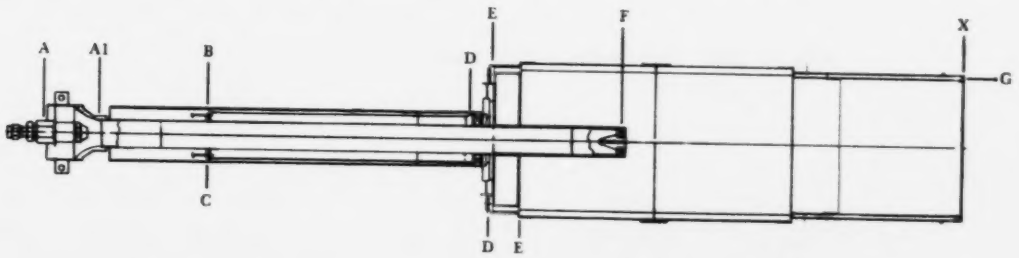


LB	AREF	L/D	VOLREF	ACDSUM
33.47	19.63	6.69	339.0	3.13

STATION	AX	ACD
A	2.924	0.210
A1	0.679	0.0
B	0.679	0.0
C	0.679	0.0
D	0.679	0.0
E	19.079	0.0
F	19.079	0.874
G	19.079	1.187
X	113.040	0.859

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.20	1.00	0.0
BST2	11.20	1.00	0.0
BST4	19.20	2.61	0.0

Figure 107. Bench-Scale Combustor Scheme 7-5A

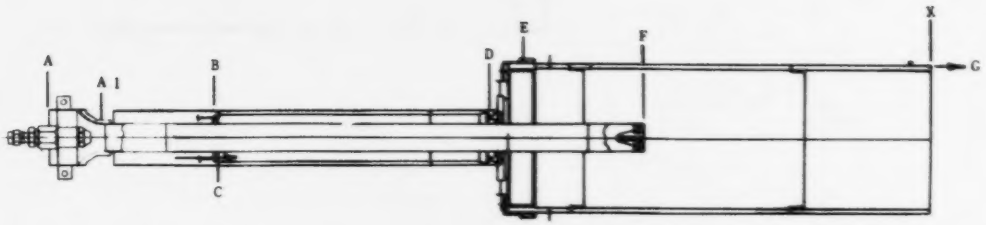


LB	AREF	L/D	VOLREF	ACDSUM
33.50	19.63	6.70	339.6	3.09

STATION	AX	ACD
A	2.924	0.210
A1	0.679	0.0
B	0.679	0.0
C	0.679	0.0
D	0.679	0.0
E	19.079	0.0
F	19.079	0.874
G	19.079	1.187
X	113.040	0.824

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST2	6.00	1.00	0.0
BST4	19.00	2.61	0.0
BST0	0.0	0.0	0.0

Figure 108. Bench-Scale Combustor Scheme 7-6A



LB	AREF	L/D	VOLREF	ACDSUM
31.44	19.63	6.29	299.1	3.01

STATION	AX	ACD
A	2.924	0.210
A1	0.679	0.0
B	0.679	0.0
C	0.679	0.0
D	0.679	0.0
E	18.848	0.0
F	18.848	0.874
G	18.848	1.187
X	113.040	0.739

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST2	6.00	1.00	0.0

Figure 109. Bench-Scale Combustor Scheme 7-7A

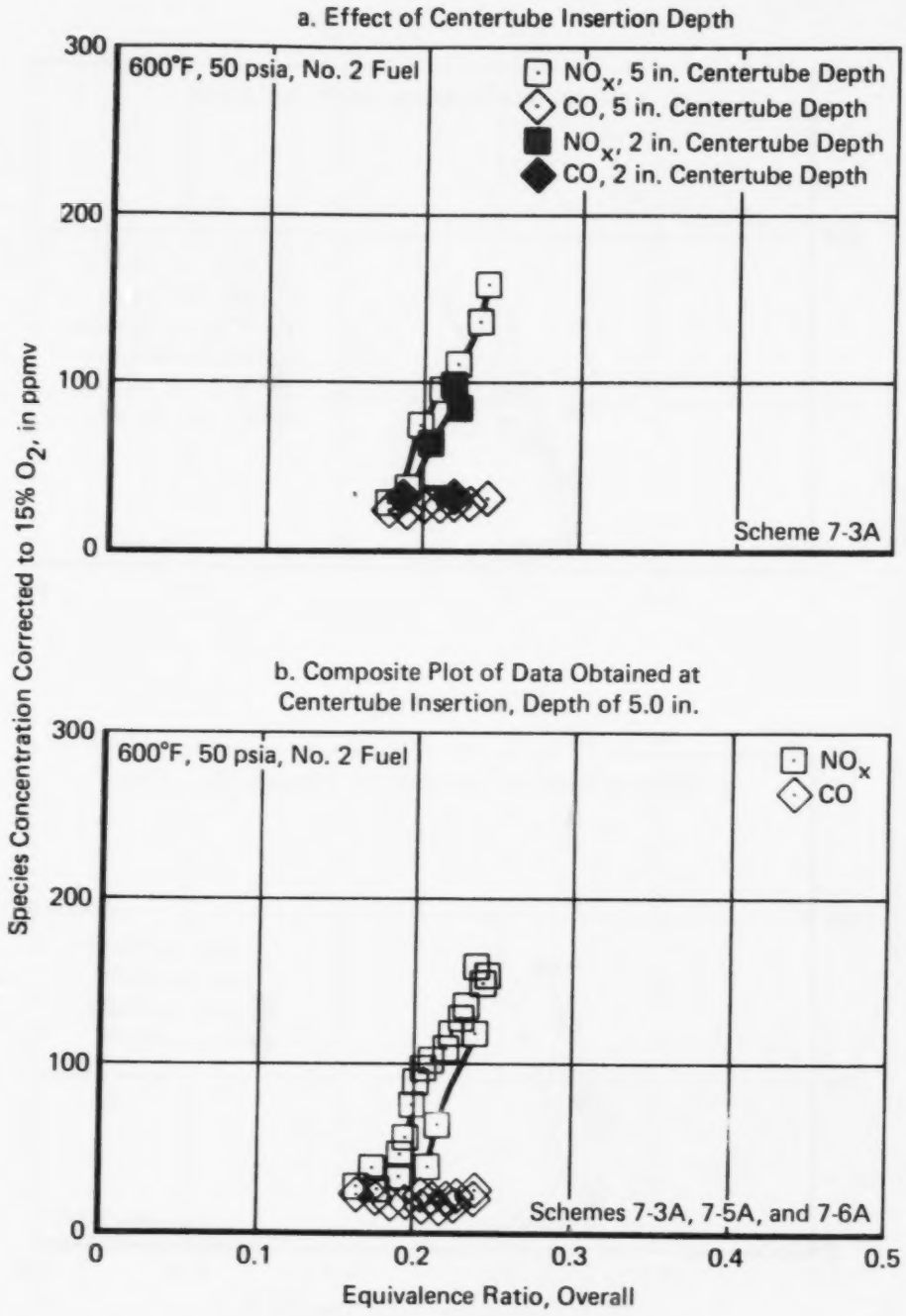


Figure 110. Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner. a. Effect of Centertube Insertion Depth. b. Composite Plot of Data Items

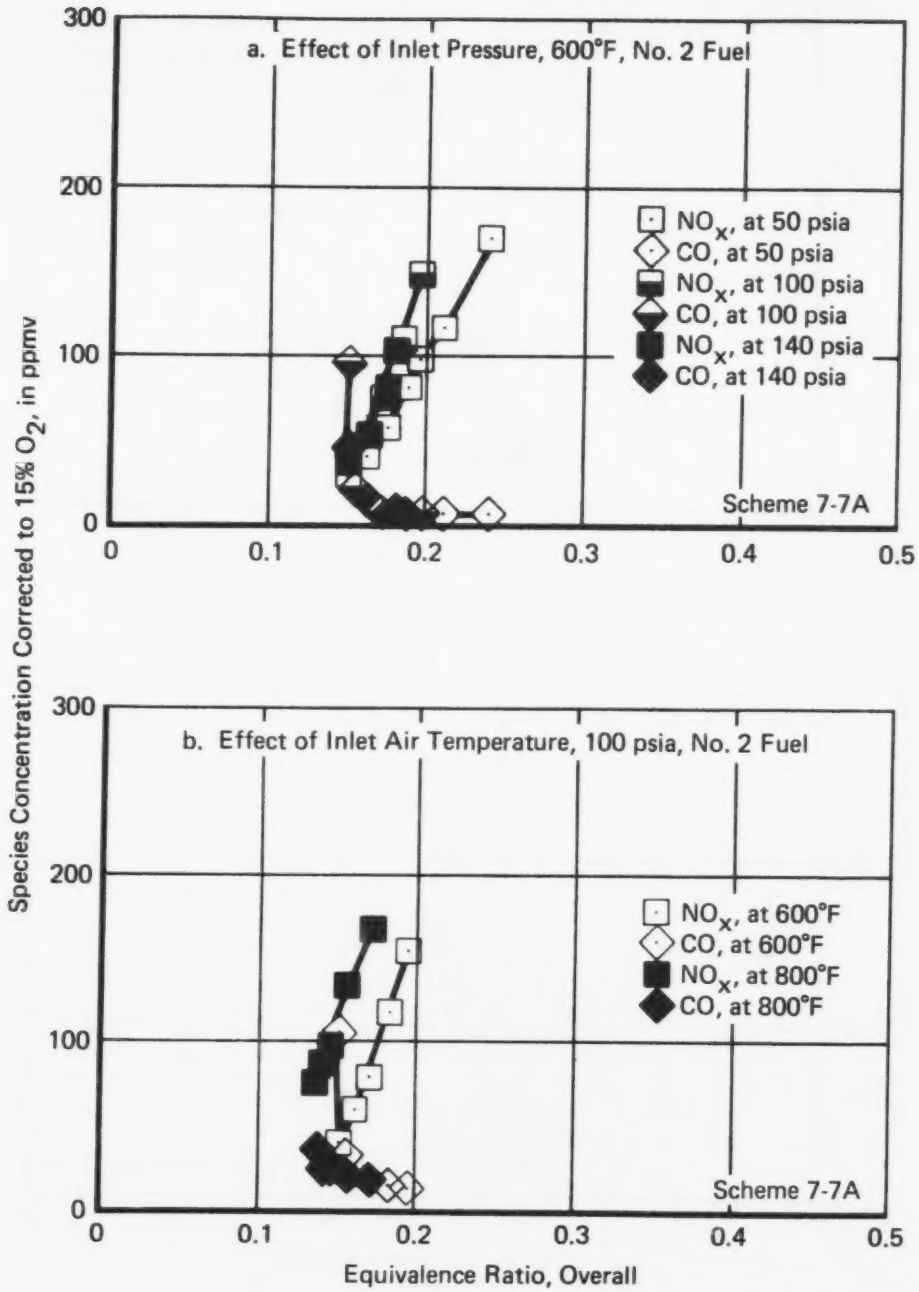


Figure 111. Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner

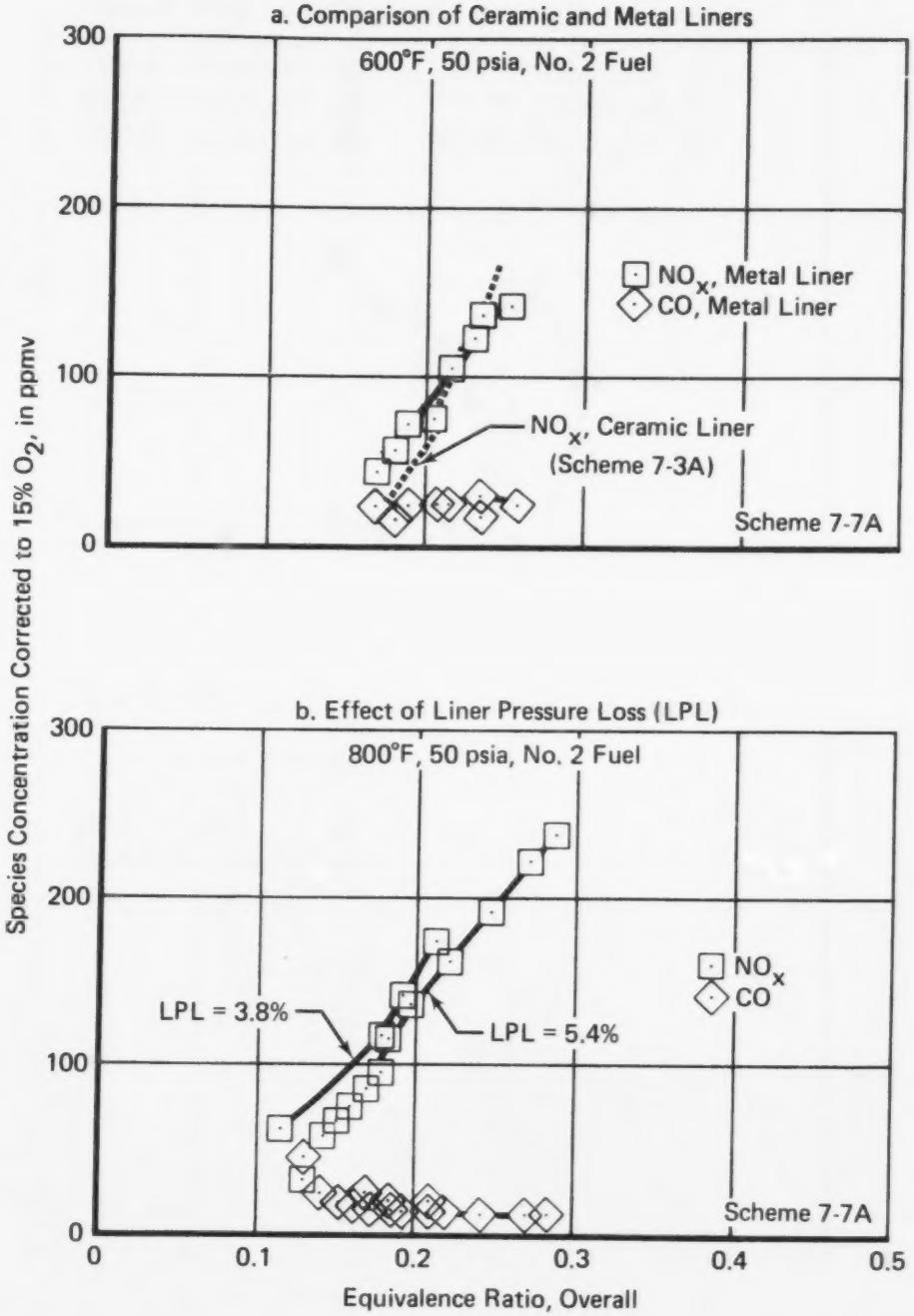


Figure 112. Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner. a. Comparison of Ceramic and Metal Liners. b. Effect of Liner Pressure Loss (LPL)

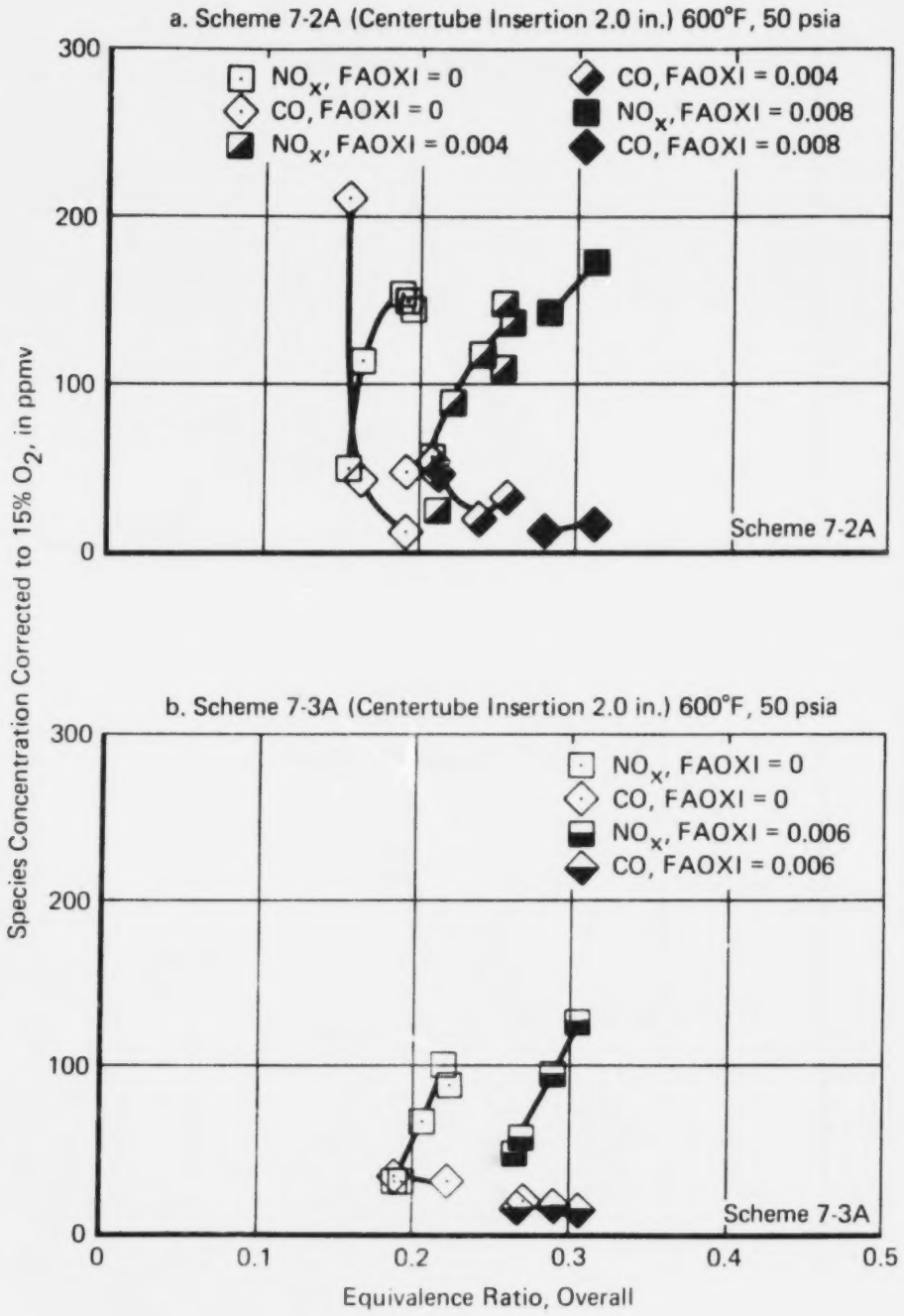


Figure 113. Variation in Species Concentration With Equivalence Ratio for Concept No. 7 — Staged Centertube Burner (Staging Effects). a. Scheme 7-2A (Centertube Insertion 2.0 in.). b. Scheme 7-3A (Centertube Insertion 2.0 in.)

The effect of centertube insertion depth is indicated in Figure 110. Results obtained at depths of two and five inch were identical (same shape curves and same minimum NO_x concentrations) except for a very slight separation in the positions the two NO_x curves on the X-axis; this separation is believed to be the result of slight differences in the amounts of airflow that may leak past the rear seal of the burner during testing (increased leakage causes a shift to the left in the NO_x curve). Although the data presented in Figure 110 show the burner to have been insensitive to changes in centertube depth in the range from two to five inches, tests conducted briefly at a depth of zero inches (i.e., with the swirlers of both centertubes mounted flush with the dome) showed that a stable flame could not be maintained. Thus, on the basis of the tests conducted to date, it appears that the centertube structure may have been instrumental in providing flame stability at the very low equivalence ratios required for low NO_x.

The effects of inlet air pressure and temperature are shown in Figure 111. Compared to the baseline operating conditions of 50 psia and 600°F (most of the data having been obtained at those conditions) it was anticipated that higher NO_x concentrations would be measured at 100 and 140 psia (roughly in accordance with the square root of the pressure ratio), and at 800°F (as a function of the higher flame temperature). These effects should be readily observable in a well premixed, prevaporized burner of the type under evaluation.

The pressure effects, shown in Figure 111a, did conform approximately to expectations. NO_x concentrations measured at 100 psia were higher than those measured at 50 psia by a factor roughly equal to the square root of the pressure ratio. However, the NO_x data measured at 140 psia appear to fall on the same curve as the data measured at 100 psia. No satisfactory explanation for this result is known. A noteworthy feature of the data is the steeper slope of the NO_x curves at higher pressures; this is consistent with the expectation of higher reaction rates at elevated pressures.

Data measured at two different values of inlet air temperature are shown in Figure 111b. The NO_x curve for tests conducted at 800°F lies farther to the left and has somewhat higher concentration levels than the one for tests at 600°F. It might well be postulated that these effects are the result of higher flame temperatures and broader flammability limits (enabling the burner to be operated at lower equivalence ratios) — both caused by increased inlet air temperature. Unfortunately this explanation is open to question because the effect of inlet air temperature on flame temperature is much less than the measured NO_x data might indicate (more than a two-fold increase in NO_x was registered — considerably more than would be expected as the result of a simple increase in flame temperature of about 100°F). Although the influence of increased inlet air temperature may in some cases be more than a simple increase in flame temperature (if for example it causes burning to be initiated earlier and persist for a longer period of time, then significantly higher NO_x concentrations may result), the postulated explanation should be held as tentative because of the possibility of other strong influences (such as unsuspected differences in the rate of leakage at the rear seal of the burner) which could have the same effect of shifting the NO_x curves to the left or right on the X-axis.

A comparison of the effects of ceramic and metal combustion chamber liners is shown in Figure 112. Six of the seven configurations of the staged centertube burner tested (Schemes 7-1A through 7-6A) incorporated a ceramic liner section as shown in Figure 104. In Scheme 7-7A this section was replaced by a metal liner (thick-wall, stainless steel, uncooled) of equal length. A comparison of the data in Figure 112 indicates that there were no major differences in the concentrations of NO_x and CO measured using the two configurations. Although there were slight differences in the shapes of the NO_x curves, neither of the two liners appear to offer any significant advantage over the other.

The effect of liner pressure loss is shown in Figure 112. There appears to have been no significant differences between the emission characteristics of the burner at 3.8% and 5.4% liner pressure loss. It might have been expected that the increased turbulence and higher premixing velocities associated with a higher liner pressure loss (changes in LPL were effected simply by increasing burner airflow) would lead to a more uniform fuel-air mixture in the primary zone, with more sharply delineated blowout characteristics, and perhaps a steeper NO_x curve. There is some evidence of an effect of this type at the lower equivalence ratios, where the curve for 3.8% LPL extends to a lower value of equivalence ratio, and is less steep. However, only one data point is available for this comparison; the results must therefore be considered inconclusive.

In the tests already discussed, fuel was introduced into the outer premixing passage only (see Figure 104). Typically, the NO_x curves generated in these tests were very steep, descending rapidly to very low concentrations as the burner overall equivalence ratio was decreased. The lowest NO_x concentrations were found at equivalence ratios slightly higher than the lean-limit-extinction point. As the steep positive slope of the curve indicates, the NO_x concentrations measured at equivalence ratios only a little higher than the minimum point were unacceptably high, failing to meet the program goal of 50 ppmv NO_x for neat No. 2 fuel. Thus, the burner configuration as tested, with only one premixing passage in use, must be considered as having only a single operating point for low-level exhaust emissions. Although this operating point can easily be adopted as the design point of the combustor, it is necessary to operate the engine over a wide range of power settings, and the combustor must not only remain lit and burn efficiently at off-design point conditions, it must also produce acceptably low concentration levels of NO_x. To meet these requirements, some method of achieving satisfactory multiple-point operation must be devised. One promising approach is staged combustion, where fuel flow is split between two or more zones, allowing axial control over stoichiometry.

In the burner configuration shown in Figure 104, staged combustion was implemented by introducing fuel into the center premixing tube, thereby augmenting and extending the flame generated by the outer premixing passage. If the equivalence ratios in the two premixing passages are carefully adjusted to achieve low flame temperatures, then low NO_x concentrations can, in theory, be achieved at a number of different operating points.

The results of staging tests conducted with the lean-front-end staged centertube combustor are shown in Figure 113. Data are presented for two Schemes, 7-2A and 7-3A; these were identical except for a minor change in the location of the fuel injector in the outer premixing tube. The results demonstrate that two operating points, each with low NO_x and CO concentrations, can be established by staging the combustion process. In Figure 113b for example, the first operating point was established at an overall equivalence ratio of 0.19, using secondary fuel flow alone (FAOX1 = 0), and resulting in concentrations of 25 ppmv NO_x and 30 ppmv CO. The second operating point was established at an overall equivalence ratio of 0.27 using both fuel zones, and resulting in concentrations of 50 ppmv NO_x and 20 ppmv CO. In the tests conducted no attempt was made to optimize the primary/secondary fuel flowsplit at operating points other than the two selected. By setting values of FAOX1 other than 0.006, it should be possible to establish low-emission operating points over a fairly wide range of overall equivalence ratios.

The results obtained, and the conclusions formulated in the tests conducted with Concept No. 7 can be summarized as follows:

1. Concentrations of NO_x and CO low enough to meet the program goals using neat No. 2 fuel can be achieved at a single operating point in a staged centertube combustor (single zone, lean-front-end).

2. The centertube structure appears to be instrumental in maintaining flame stability.

3. Centertube insertion depth has no effect on emission concentration levels in the range between 2 and 5 inch.

4. Low concentrations of NO_x and CO can be achieved at two operating points by two-zone staged combustion.

5. Ceramic combustion chamber liners offer no apparent advantage over metal liners in terms of emission concentration levels.

3.3.8 Evaluation of Concept No. 8 — Exhaust Gas Recirculation

Tests of this concept were not conducted, although the experimental hardware necessary for initial exploratory evaluation had been fabricated. In Figure 114, the exhaust gas recirculation module is shown. A typical configuration of the experimental hardware as it might be arranged for evaluation of the Exhaust Gas Recirculation (EGR) concept is depicted in Figure 115. There were novel features to the concept that may merit investigation in future experimental studies. The use of side-mounted ejectors, driven by the incoming primary zone airflow, for the abstraction of combustion gases (or secondary zone products of combustion, depending upon placement of the EGR module) provides an extended mixing length within the recirculation conduit. Within this length, a more uniform mixture of the recycled gases and the incoming airflow can be achieved than in schemes which provide mixing only at the end of the recirculation conduit. The greater uniformity achieved can be expected to reduce hot streaks that may cause preignition when the EGR module is used in conjunction with a fuel-air premix tube. In addition to the evaluation of this particular module design; future studies might also include parametric variations in the placement of the EGR module. The abstraction of gases at various sites along the length of the combustor, and the reintroduction of these gases at various other sites within both the primary zone and secondary zone, holds promise for a new dimension of combustion control. The pursuit of these objectives was not undertaken under the current program because of funding and schedule constraints, and because of the demonstrated success of Concept No. 29, Rich Burn/Quick Quench in meeting all program objectives.

3.3.9 Evaluation of Concept No. 9 — Hydrogen Enrichment

This concept was eliminated from further consideration at the end of Phase I, because of the implicit requirement for an external source of hydrogen. It had been decided that the introduction of additive materials (including water) would not be considered under the current program, because of the intended emphasis on "dry" NO_x control techniques.

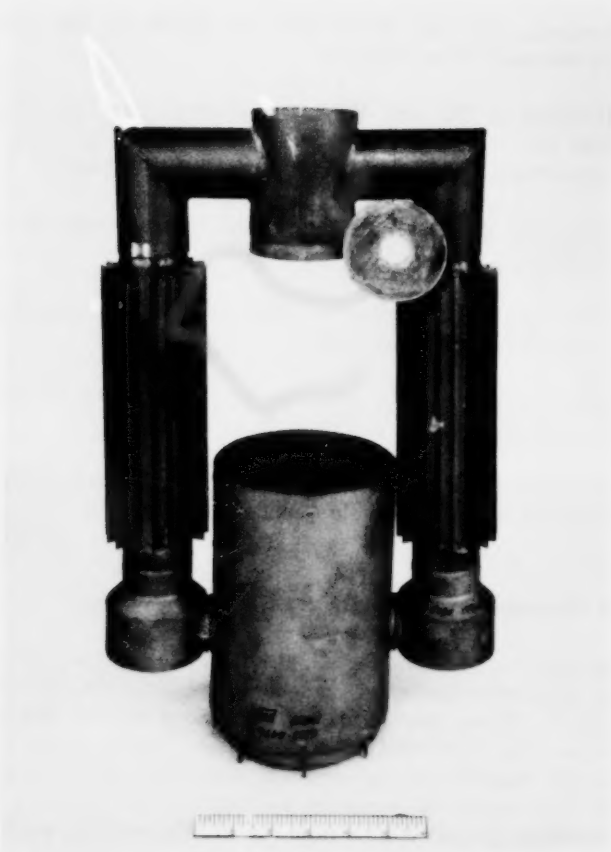


Figure 114. Exhaust Gas Recirculation Module

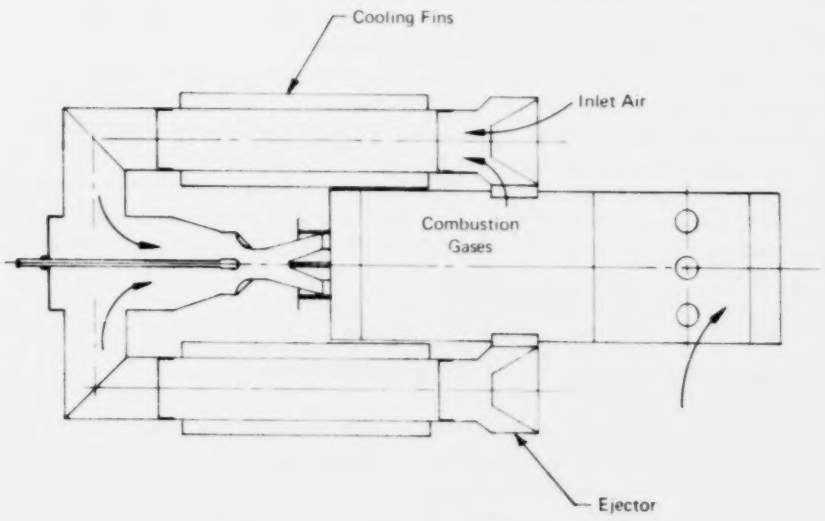


Figure 115. EGR Combustor Scheme

3.3.10 Evaluation of Concept No. 10 — Surface Combustion

Tests of this concept were not conducted, although fabrication of a surface combustion porous plate flameholer (Figure 116) had been accomplished prior to the experimental program. This flameholder, which contained imbedded cooling tubes for temperature control, was judged to lack functional compatibility with the other bench-scale combustor modular hardware, because of its very low airflow capacity, and because of the lack of knowledge of any premixing device capable of distributing fuel and air over the surface of the flameholder without danger of flashback.

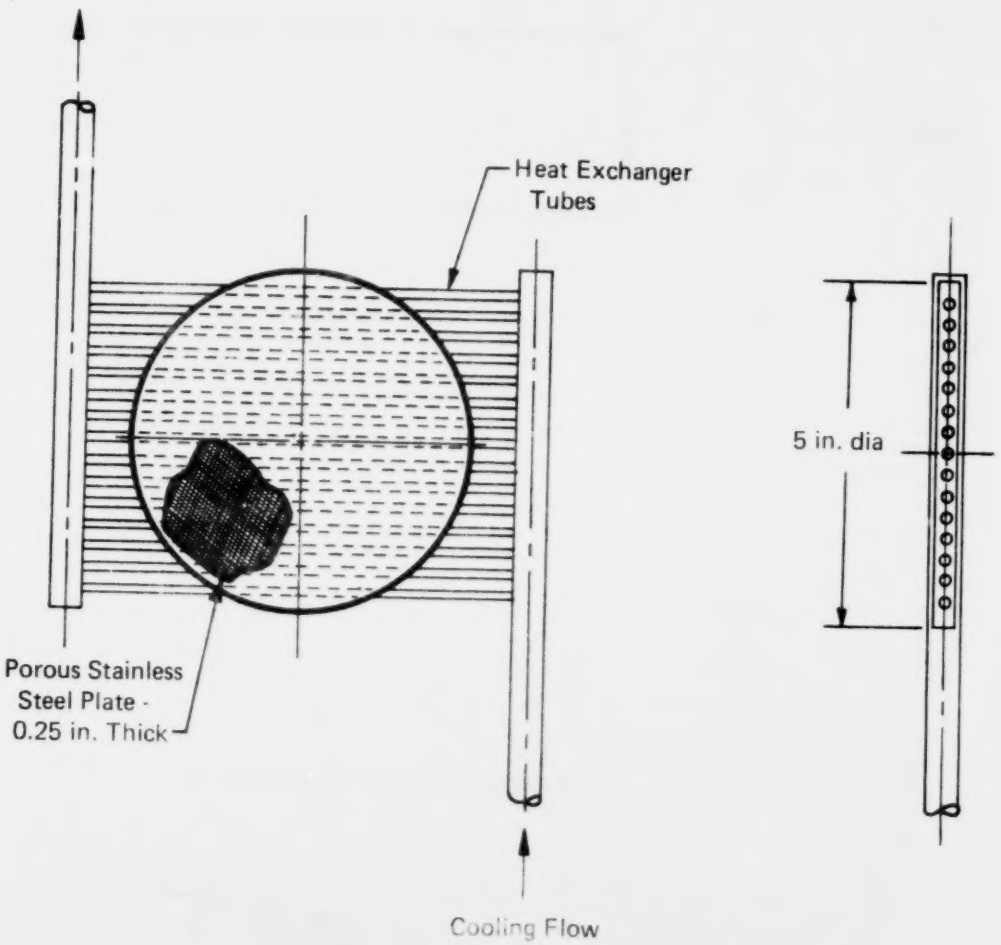
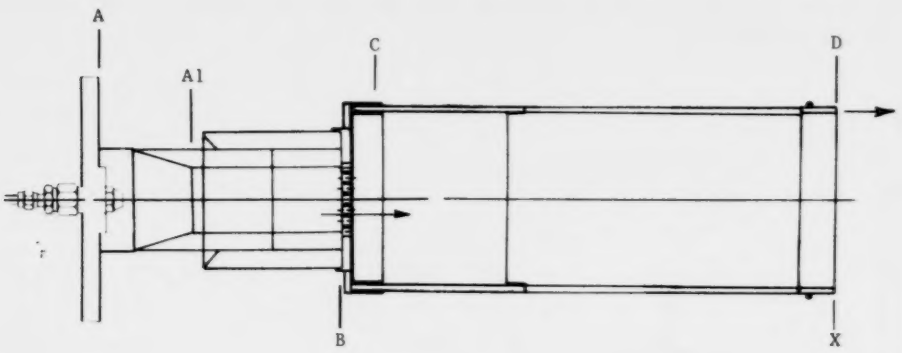


Figure 116. Porous Plate Flameholders

3.3.11 Evaluation of Concept No. 11 — Distributed Flame

Limited tests were conducted of this lean-burning concept to isolate those flameholder design features that may enhance the stability of low-temperature (lean) flames. One approach (that embodied in the Distributed Flame concept is to avoid large, highly turbulent recirculation zones (such as those produced by swirlers), and to set up, as an alternatve, a plurality of smaller flame jets, each independently stabilized and characterized by lower flame turbulence. As in tests of other lean burning concepts, preignition of the fueair mixture within the premix tube was a recurrent problem.

The initial configuration, Scheme 11-1A, is shown in Figure 117. Experimental hardware representative of that tested is shown in Figure 118. Results of the first test series indicated that inadequate premixing had been achieved (NO_x and CO) emission signature curves were found to be characteristic of diffusion burning), and that damage to the perforated plate (due to preignition) had occurred.



LB	AREF	L/D	VOLREF	ACDSUM
21.75	19.63	4.35	267.3	4.12

STATION	AX	ACD
A	0.739	0.0
A1	2.909	0.0
B	2.909	1.310
C	19.079	0.0
D	19.079	1.157
X	113.040	1.618

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	2.50	1.50	0.0
BST2	7.60	2.00	0.0
BST3	12.25	2.91	0.0
BST4	19.25	2.81	0.0

Figure 117. Bench-Scale Combustor Scheme 11-1A

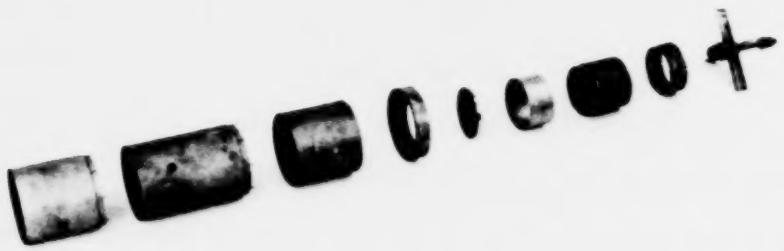
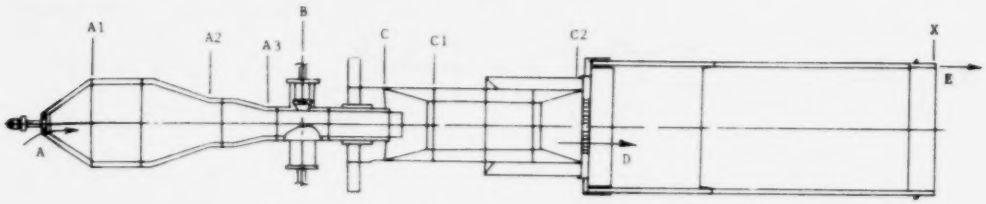


Figure 118. Experimental Hardware Used in the Evaluation of Concept No. 11 — Distributed Flame

In subsequent tests various fuel-preparation devices and flameholders were evaluated. Beginning with Scheme 11-2A, the rich preburner module developed under Concept No. 4 Superlean with Preburner, and under Concept No. 28, Rich Preburner (see Sections 3.3.4 and 3.3.28) was utilized in conjunction with both perforated plate and conventional swirler flameholders. The configurations tested, Schemes 11-2A through 11-5A, are shown in Figures 119 through 122. In Table VII, a summary of the flameholders tested is provided. Tests involving the rich preburner module were conducted at fuel-rich primary zone operating conditions to provide data supporting various other rich burning concept investigations that were proceeding in parallel. Results were generally unsuccessful because of inadequate premixing and poor fuel preparation. No significant emissions data were obrained. Qualitatively, it was learned that the rich preburner module had a pronounced tendency to cause preignition. Insufficient data were obtained to make comparison of the two flameholder types.

Scheme 11-6A utilized a perforated plate flameholder and an air-boost nozzle, as shown in Figure 123, and was designed for fuel-lean operation. Data points recorded indicated that diffusion burning had been predominant, possibly due to inadequate dispersion of droplets from the centrally mounted air-boost fuel nozzle over the cross-section of the premixing passage.

Tests of four configurations were conducted firing low Btu gaseous fuel. Schemes 11-7A and 11-8A, shown in Figures 124 and 125, both employed a conventional swirler flameholder. Schemes 11-9A and 11-10A, shown in Figures 126 and 127, both employed an alternative flameholder design featuring multiple V-gutters. Except for minor variations, the four configurations were the same, making it possible to compare the two flameholder designs. The swirler schemes served as a baseline while the alternative design produced eight individually stabilized jets of flame without getting up a large central recirculation zone. In order to eliminate the influence of fuel vaporization on the test results, a gaseous fuel was employed (in this case, low Btu gas, which was more readily available than natural gas at the time). Composition of the gaseous fuel is given in Table IV, Section 3.2.4.

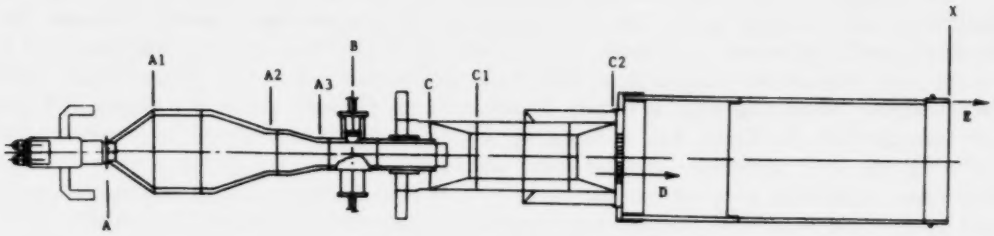


LG	AREF	L/D	VOLREF	ACDSUM
36.05	19.63	7.21	274.8	3.71

STATION	AX	ACD
A	0.502	0.009
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	6.739	0.253
C1	2.909	0.0
C2	12.124	0.0
D	19.079	0.0
E	19.079	1.187
X	113.040	2.264

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.75	0.0
BST2	16.80	1.50	0.0
BST3	26.55	2.81	0.0
BST4	33.55	2.81	0.0

Figure 119. Bench-Scale Combustor Scheme 11-2A

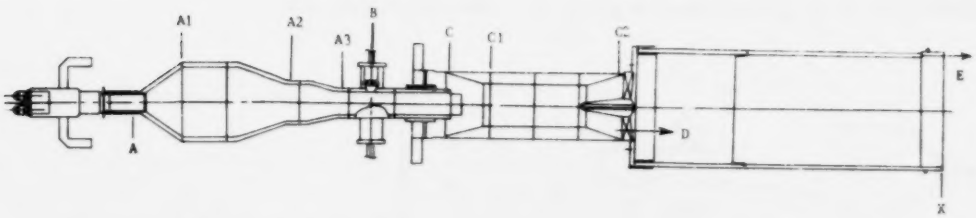


LB	AREF	L/D	VOLREF	ACDSUM
36.05	19.63	7.21	274.8	3.68

STATION	AX	ACD
A	0.502	0.025
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	6.739	0.253
C1	2.909	0.0
C2	12.124	0.0
D	19.079	0.0
E	19.079	1.187
X	113.040	2.215

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.60	1.75	0.0
BST2	16.80	1.50	0.0
BST3	26.55	2.81	0.0
BST4	33.55	2.81	0.0

Figure 120. Bench-Scale Combustor Scheme 11-3A

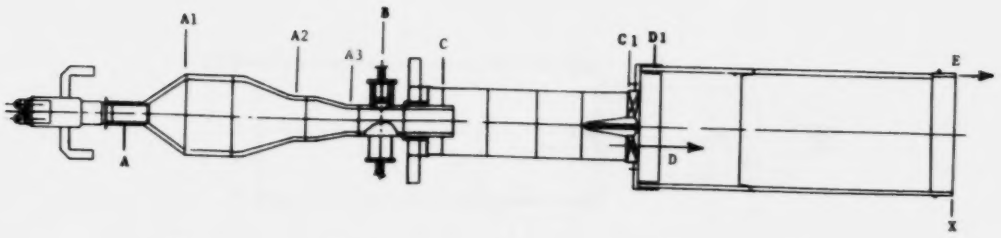


LB	AREF	L/D	VOLREF	ACDSUM
37.62	19.09	7.67	267.2	2.74

STATION	AX	ACD
A	0.631	0.016
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	6.739	0.278
C1	2.909	0.0
C2	6.739	0.0
D	2.491	0.0
E	19.079	1.187
X	113.040	1.260

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	12.50	0.52	0.0
BST3	28.32	2.81	0.0
BST4	35.32	2.81	0.0

Figure 121. Bench-Scale Combustor Scheme 11-4A



LB	AREF	L/D	VOLREF	ACDSUM
37.13	19.09	7.53	267.2	2.71

STATION	AX	ACD
A	0.031	0.016
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.664	0.0
C	6.739	0.276
C1	0.739	0.0
D	2.491	0.0
D1	19.079	0.0
E	19.079	1.187
X	113.040	1.229

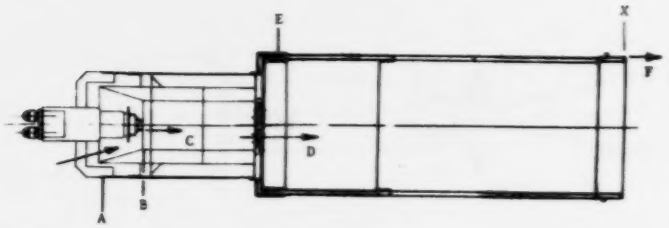
HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	1.75	0.0
BST2	11.50	0.52	0.0
BST3	27.63	2.81	0.0
BST4	34.63	2.61	0.0

Figure 122. Bench-Scale Combustor Scheme 11-5A

TABLE VII. CONFIGURATIONS TESTED IN THE EVALUATION OF CONCEPT NO. 11

/Scheme/Flameholder/Fuel Injector		
11-1A	I	A
11-2A	I	B
11-3A	I	C
11-4A	II	C
11-5A	II	C
11-6A	I	D
11-7A	II	E
11-8A	II	E
11-9A	III	E
11-10A	III	E
11-11A	II	C
11-12A	II	C

Flameholders	*Fuel Injectors*
I - Perforated Plate	A - Pressure Atomizing
II - Swirler	B - Air Blast Preburner/ Pressure Atomizing Primary
III - "V-Gutter"	C - Air-Boost Preburner/ Pressure Atomizing Primary
	D - Air-Boost
	E - Open Tube (Gaseous Fuel)

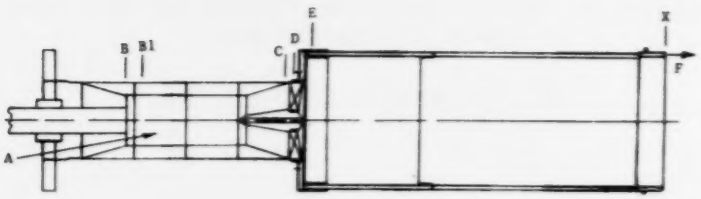


LB	AREF	L/D	VOLREF	ACDSUM
19.75	19.09	4.60	267.2	3.33

STATION	AX	ACD
A	3.479	1.304
B	1.804	0.0
C	2.909	0.033
D	1.301	0.0
E	19.079	0.0
F	19.079	1.187
X	113.340	0.812

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.50	2.00	0.0
BST2	5.00	4.00	0.0
BST3	10.25	2.81	0.0
BST4	17.25	2.81	0.0

Figure 123. Bench-Scale Combustor Scheme 11-6A

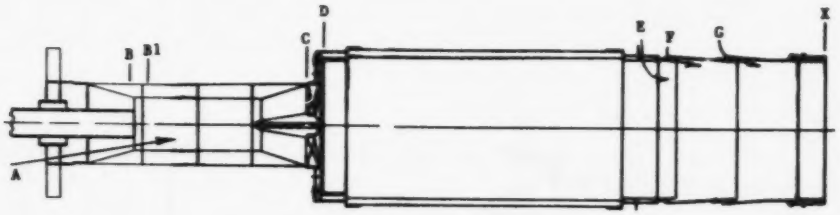


LB	AREF	L/D	VOLREF	ACDSUM
25.02	19.09	5.07	267.2	4.36

STATION	AX	ACD
A	5.957	1.207
B	1.807	0.0
B1	2.916	0.0
C	0.188	0.0
D	2.491	0.0
E	19.079	0.0
F	19.079	1.187
X	113.340	1.385

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.50	1.50	0.0
BST2	10.00	1.50	0.0
BST3	14.00	2.81	0.0
BST4	22.00	2.81	0.0

Figure 124. Bench-Scale Combustor Scheme 11-7A

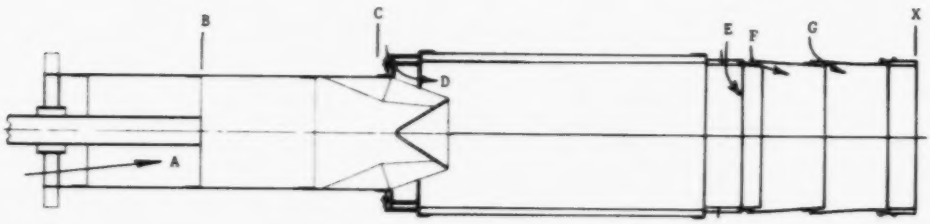


LB	AREF	L/D	VOLREF	ACDSUM
30.41	19.09	6.17	380.8	5.05

STATION	AX	ACD
A	5.957	1.807
B	1.607	0.0
B1	2.910	0.0
C	6.188	0.0
D	19.079	0.162
E	19.079	1.187
F	19.625	0.119
G	19.625	0.119
X	113.040	1.657

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.50	1.50	0.0
BST2	8.50	1.50	0.0
BST3	12.00	2.81	0.0
BST4	23.30	2.66	0.0

Figure 125. Bench-Scale Combustor Scheme 11-8A

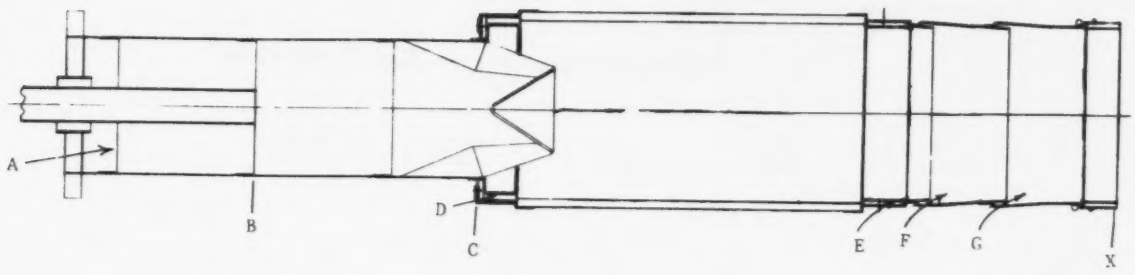


LB	AREF	L/D	VOLREF	ACDSUM
31.39	19.09	6.37	390.8	7.29

STATION	AX	ACD
A	2.570	2.570
B	11.345	0.0
C	12.130	0.0
D	19.079	0.162
E	19.079	1.187
F	19.625	0.119
G	19.625	0.119
X	113.040	3.138

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	8.00	2.00	0.0
BST2	11.50	2.00	0.0
BST3	13.50	2.81	0.0
BST4	24.27	2.66	0.0

Figure 126. Bench-Scale Combustor Scheme 11-9A



LB	AREF	L/D	VOLREF	ACDSUM
31.39	19.09	6.37	380.8	5.83

STATION	AX	ACD
A	2.570	1.750
B	11.345	0.0
C	12.130	0.0
D	19.079	0.162
E	19.079	1.187
F	19.625	0.119
G	19.625	0.119
X	113.040	2.490

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	2.00	0.0
BST2	11.50	2.00	0.0
BST3	13.50	2.81	0.0
BST4	24.27	2.66	0.0

Figure 127. Bench-Scale Combustor Scheme 11-10A

A comparison of the NO_x and CO concentrations measured in these tests s shown in Figure 128. For both flameholders, NO_x concentrations were very low (5 to 30 ppmv) reflecting the face that ambient temperature low-Btu gas, without ammonia, was used. CO concentrations were high, because of the close proximity of lean limit extinction. The "v-gutter" flameholder produced lower CO but higher NO_x than the swirler. In addition, the tradeoff between NO_x and CO was poorer for the "v-gutter;" this result may be seen by visualizing a rightward shift of both curves for the "v-gutter" (as miught be effected by adding more air flow to the premixing tube, making the primary zone leaner), and noting that NO_x concentrations for the "v—gutter" would remain higher than those for the swirler even when the two CO curves coincide. A tentative conclusion drawn from this comparison was that flame stability in the case of the "v-gutter" is achieved in a manner that causes local regions of higher temperature and increased residence time to form (perhaps in the wakes of the radial "v-gutters"), with the result that NO_x concentration levels are higher for a given level of CO.

A final series of tests was performed utilizing an improved preburner module for liquid fuel prevaporization. The two configurations evaluated, Schemes 11-11A and 11-12A (shown in Figures 129 and 130), differed only in the fuel nozzles used in the preburner device. Tests were conducted at fuel-lean primary zone operating conditions. Conventional swirler flameholders were employed in order to establish baseline results. The data obtained indicated that substantial diffusion burning had still taken place. For this reason comparative tests with a distributed flameholding device were not undertaken.

While no conclusive information was obtained from these tests of the Distributed Flame concept, it was evident that the tradeoff between NO_x and CO can be affected by means of flame stabilization. This concept was retired.

3.3.12 Evaluation of Concept No. 12 — Ceramic Liner Combustor

Although a comprehensive evaluation of liner cooling techniques was not meant to be part of the overall program, ceramic liners were identified as a secondary design concept, to undergo limited exploratory testing, and to be considered as a candidate for later definitive testing. The use of ceramic liner materials can help reduce emissions and control the burning of hydrocarbon fuels in two ways. First, the elimination of liner film cooling airflow prevents air quenching of the combustion gases adjacent to the liner and precludes the formation of NO_x due to local diffusion burning. Second, the increased operating temperature capability of the ceramic material (in comparison to metal liners) increases the radiative interchange between the liner and the combustion zone. The rate of burning of carbon particulate material that may be formed under certain conditions, and with some fuels is directly affected. The particles formed are small, radiate intensely, and tend to take on the temperature of the surrounding liner. If the liner is hot, the particles also tend to be hot and burn quickly.

The exploratory tests involved the substitution of nonmetallic liner test sections for conventional designs that employ air cooling during the screening tests of various other concepts. Silicon carbide cylindrical test sections were used. The ceramic pieces, which had a nominal wall thickness of 0.25 in., were mounted as shown in Figure 131, and were made interchangeable with corresponding metallic liner sections. In Table VIII, the combustor schemes that utilized ceramic liner sections are listed. Reference is made to the other paragraphs of this section, in which the test results for the schemes listed are described.

In general the use of ceramic liner test sections was found to be operationally difficult. Thermal gradients within the thick-wall material led to frequent cracking of the cylinders. No significant benefits were noted in terms of NO_x or CO concentration levels, in comparison to other available cooling techniques (such as backside convective cooling) that do not require the discharge of cooling airflow through the cooled surface into the combustion zone.

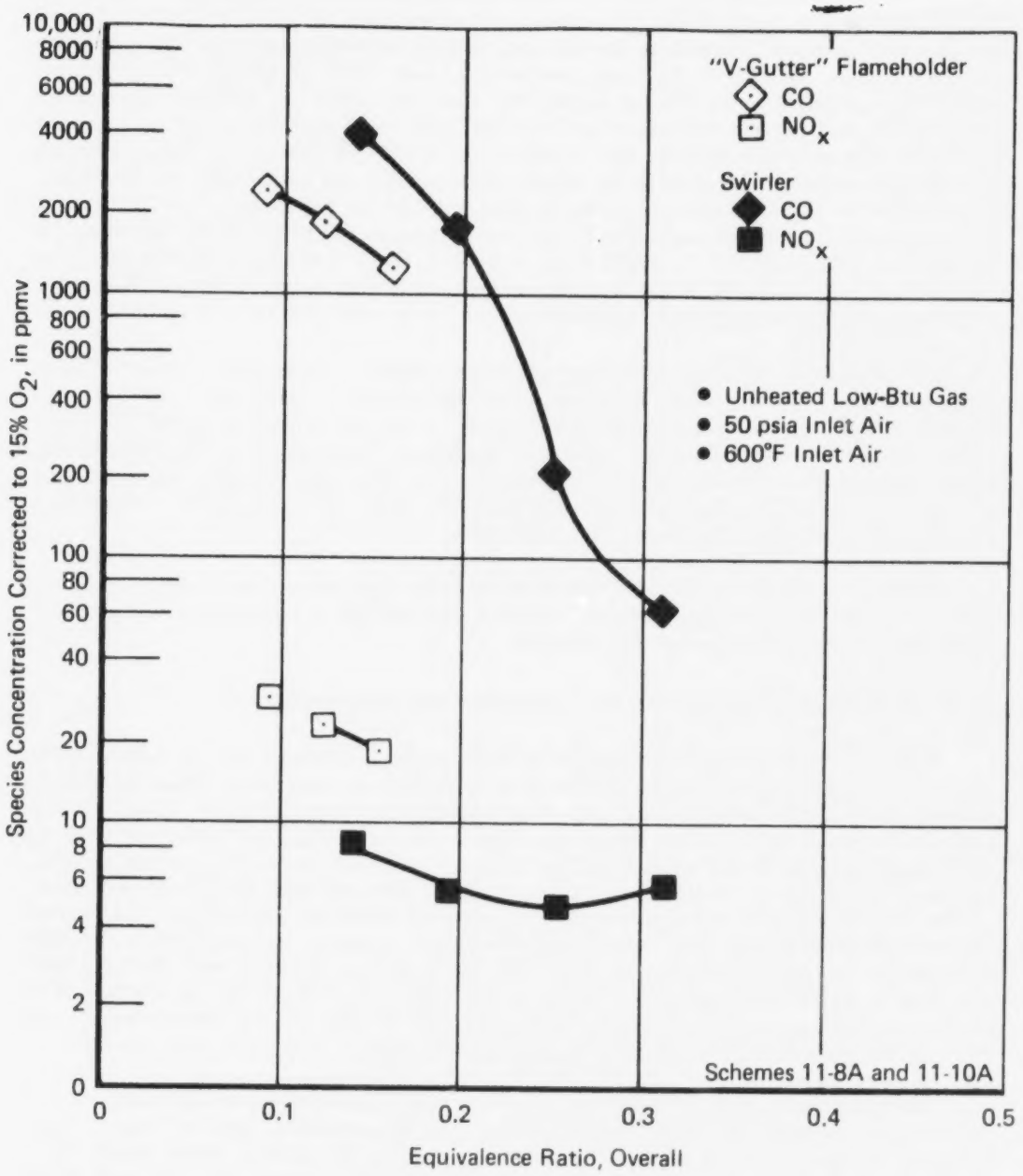
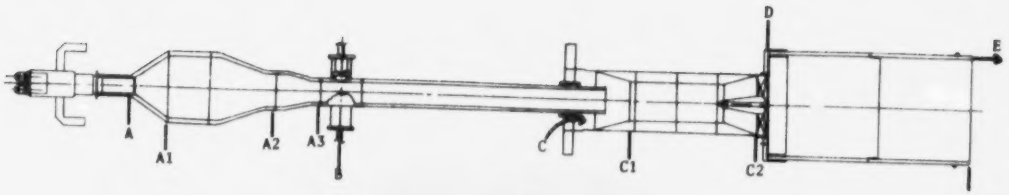


Figure 128. Comparison of Variation in Species Concentration With Equivalence Ratio for Two Flameholder Types in Concept No. 11 (Distributed Flame)

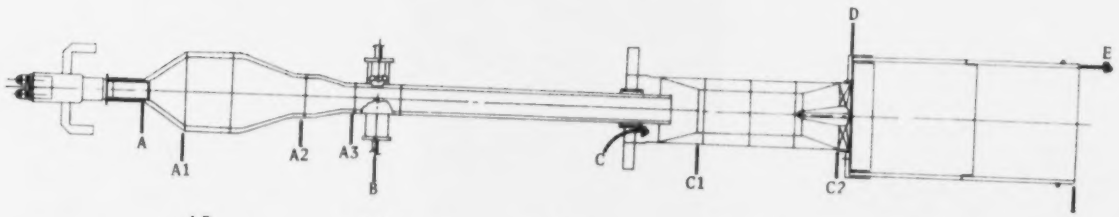


LB	AREF	L/D	VOLREF	ACDSUM
43.02	19.09	8.72	1903.9	3.70

STATION	AX	ACD
A	0.031	0.021
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	2.491
C1	2.909	0.0
C2	6.739	0.0
D	2.491	0.0
E	19.079	1.187
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.00	1.75	0.0
BST2	18.00	0.66	0.0
BST3	29.50	1.50	0.0
BST4	39.00	2.66	0.0

Figure 129. Bench-Scale Combustor Scheme 11-11A



LB	AREF	L/D	VOLREF	ACDSUM
43.02	19.09	8.72	1903.9	3.70

STATION	AX	ACD
A	0.031	0.021
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	2.491
C1	2.909	0.0
C2	6.739	0.0
D	2.491	0.0
E	19.079	1.187
X	113.040	0.0

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.00	1.75	0.0
BST2	18.00	0.66	0.0
BST3	29.50	1.50	0.0
BST4	39.00	2.66	0.0

Figure 130. Bench-Scale Combustor Scheme 11-12A

Figure 131. Ceramic Liner Mounting Scheme for Bench-Scale Testing

TABLE VIII. COMBUSTOR CONFIGURATIONS HAVING CERAMIC LINER SECTIONS

Scheme No.	*Ceramic Liner*	*Location*
5-4A	5.125 ID × 5.0 Long	Primary Zone
5-5A	5.125 ID × 10.0 Long	Primary Zone
5-5B	5.125 ID × 10.0 Long	Primary Zone
5-5C	5.125 ID × 10.0 Long	Primary Zone
5-6A	5.125 ID × 10.0 Long	Primary Zone
5-7A	5.125 ID × 10.0 Long	Primary Zone
5-8A	5.125 ID × 10.0 Long	Primary Zone
5-9A	5.125 ID × 10.0 Long	Primary Zone
5-10A	5.125 ID × 10.0 Long	Primary Zone
5-10B	5.125 ID × 10.0 Long	Primary Zone
5-11A	5.125 ID × 10.0 Long	Primary Zone
5-11B	5.125 ID × 10.0 Long	Primary Zone
5-11C	5.125 ID × 10.0 Long	Primary Zone
5-12A	5.125 ID × 10.0 Long	Primary Zone
5-12B	5.125 ID × 10.0 Long	Primary Zone
5-13A	5.125 ID × 10.0 Long	Primary Zone
5-14A	5.125 ID × 10.0 Long	Primary Zone
5-15A	5.125 ID × 10.0 Long	Primary Zone
5-16A	5.125 ID × 10.0 Long	Primary Zone
5-17A	5.125 ID × 10.0 Long	Primary Zone
5-18A	5.125 ID × 10.0 Long	Secondary Zone
5-19A	5.125 ID × 10.0 Long	Secondary Zone
5-19B	5.125 ID × 10.0 Long	Secondary Zone
5-20A	5.125 ID × 10.0 Long	Secondary Zone
5-22A	5.125 ID × 10.0 Long	Secondary Zone
5-23A	5.125 ID × 10.0 Long	Secondary Zone
5-23B	5.125 ID × 10.0 Long	Secondary Zone
6-1A	5.125 ID × 10.0 Long	Secondary Zone
6-2A	5.125 ID × 10.0 Long	Secondary Zone
6-3A	5.125 ID × 10.0 Long	Secondary Zone
6-4A	5.125 ID × 10.0 Long	Secondary Zone
6-5A	5.125 ID × 10.0 Long	Secondary Zone
7-1A	5.125 ID × 10.0 Long	Primary Zone
7-2A	5.125 ID × 10.0 Long	Primary Zone
7-3A	5.125 ID × 10.0 Long	Primary Zone
7-4A	5.125 ID × 10.0 Long	Primary Zone
7-5A	5.125 ID × 10.0 Long	Primary Zone
7-6A	5.125 ID × 5.0 Long (2 parts)	Primary Zone
11-8A	5.125 ID × 10.0 Long	Primary Zone
11-9A	5.125 ID × 10.0 Long	Primary Zone
11-10A	5.125 ID × 10.0 Long	Primary Zone
14-1A	5.125 ID × 10.0 Long	Primary Zone
14-2A	5.125 ID × 10.0 Long	Primary Zone
28-1A	5.125 ID × 10.0 Long	Primary Zone
28-2A	5.125 ID × 10.0 Long	Primary Zone

3.3.13 Evaluation of Concept No. 13 — External Combustion

This concept was not evaluated explicitly in the bench-scale experimental program. The use of an externally mounted combustor (as opposed to an internally mounted design, which may be in-line or canted) provides the inherent advantage of greater available residence time. Many of the other concepts screened were tested without regard for residence time restrictions (combustion and premixing modules were generally sized to provide ample residence times). Thus many of the results reported in other parts of this section can be reviewed in the context of greater available residence time, in order to gauge their applicability to external combustion systems.

3.3.14 Evaluation of Concept No. 14 — Boost-Air Dilution

Limited tests of this concept were conducted to determine the feasibility of utilizing increased dilution air pressure drop (provided by an external compressor or other means) to achieve a higher mixing rate and reduce the time required to effect changes in equivalence ratio and gas stream temperature within the combustor. The capability for rapid mixing was viewed as extremely important in making the transition from fuel-rich to fuel-lean burning in conjunction with various rich-burning approaches to NO_x reduction.

Tests of the boost-air dilution module shown in Figure 132 were conducted using a basic rich front end, natural-gas-fueled, bench-scale burner. Two configurations were tested (Schemes 14-1A and 14-2A, shown in Figures 133 and 134), differing in the flowsplit between boosted and conventional dilution air in the aft section of the combustor. In both schemes, total dilution airflow was maintained approximately constant, but there was a difference of about two to one in the pressure drop of the boosted dilution jets.

Figure 135 shows the variation in CO and NO_x emission concentrations with overall equivalence ratio and dilution-air pressure drop for the burning of natural gas and air at a chamber pressure of 50 psia and an inlet air temperature of 600°F. Significant reductions in NO_x concentration were achieved over the power range investigated at the expense of an average dilution-air pressure drop of approximately 34 percent. When the dilution-air pressure drop was reduced to approximately 19 percent the measured NO_x concentrations were slightly higher: but the CO concentrations decreased significantly. Although a general trend in reducing NO_x emission concentrations by increasing dilution-air injection pressure appears to have been established, greater reductions were achieved later by other means that did not require an expenditure of externally supplied power (in particular, the "quick quench" technique employed in conjunction with Concept No. 29, Rich Burn/Quick Quench was successful in this regard). In this light, the Boost-Air Dilution Concept was retired.

3.3.15 Evaluation of Concept No. 15 — Artificial Excitation

This concept, which called for the use of vibrational or electronic excitation of burning gases within the combustor to increase reaction and mixing rates, was not tested in the bench-scale experimental program. Although no specific tests were planned, it had been anticipated that acoustic resonance might be encountered in the operation of the bench-scale hardware at some point during the evaluation of the other concepts. In that event, comparisons in emission concentration levels might have been made between vibrationally excited and non-excited operating points. There were no occurrences of acoustic excitation in the bench scale test program.

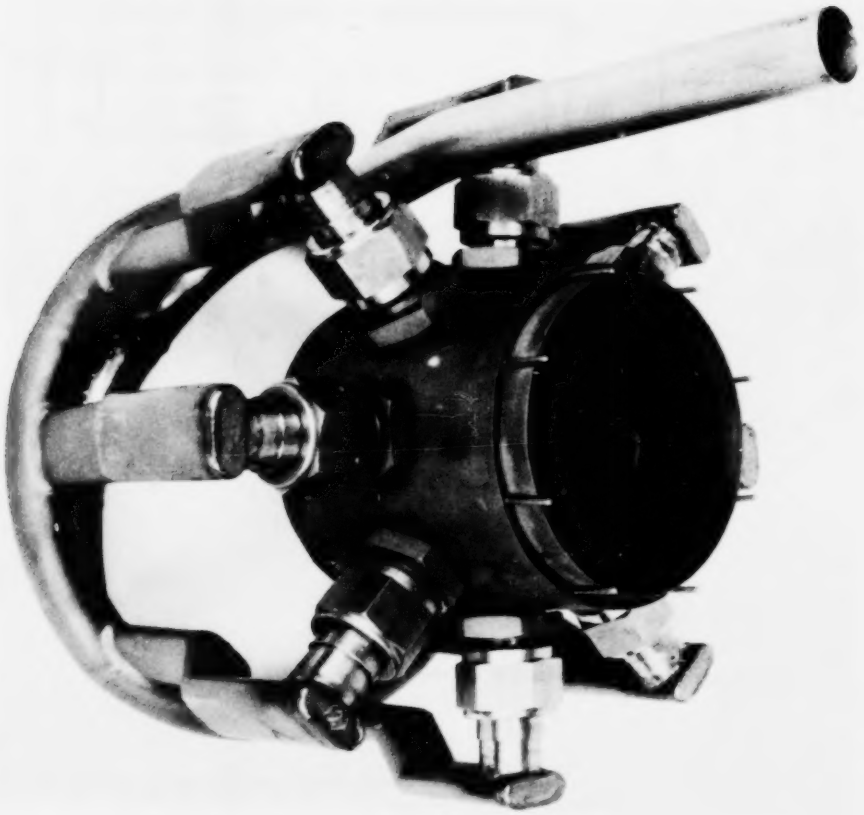
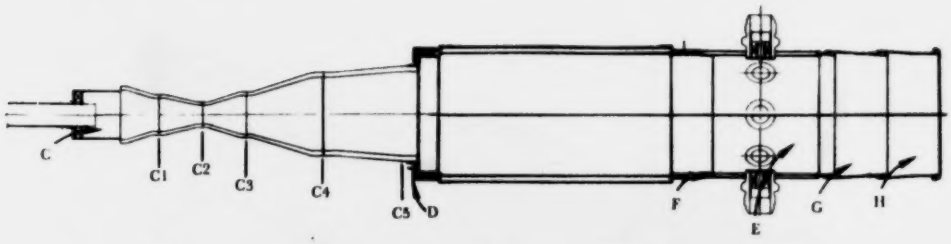


Figure 132. Boost-Air Dilution Combustor Module

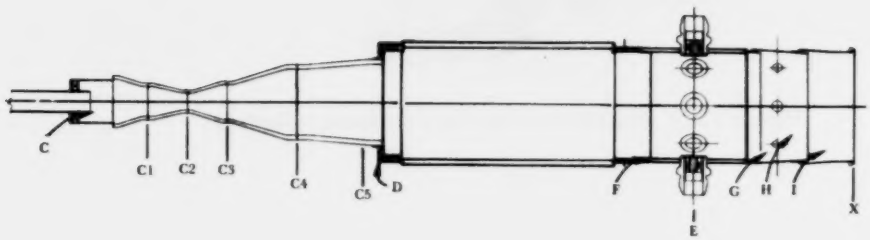


LB	AREF	L/D	VOLREF	ACDSUM
38.03	19.63	7.61	459.3	3.66

STATION	AX	ACD
C	2.924	0.501
C1	1.495	0.0
C2	0.533	0.0
C3	2.035	0.0
C4	7.389	0.0
C5	9.882	0.0
D	20.619	0.162
E	19.625	2.179
F	19.625	0.581
G	19.625	0.119
H	19.625	0.119

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.00	1.00	90.0
BST2	6.88	0.95	0.0
BST3	14.13	2.00	0.0
BST4	16.63	2.81	0.0

Figure 133. Bench-Scale Combustor Scheme 14-1A



LB	AREF	L/D	VOLREF	ACDSUM
38.03	19.63	7.61	459.3	3.16

STATION	AX	ACD
C	2.924	0.501
C1	1.495	0.0
C2	0.533	0.0
C3	2.035	0.0
C4	7.389	0.0
C5	9.882	0.0
D	20.619	0.162
E	19.625	0.0
F	19.625	0.581
G	19.625	0.119
H	19.625	0.548
I	19.625	0.119
X	113.040	1.153

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.00	1.00	90.0
BST2	6.88	0.95	0.0
BST3	14.13	2.00	0.0
BST4	16.63	2.81	0.0

Figure 134. Bench-Scale Combustor Scheme 14-2A

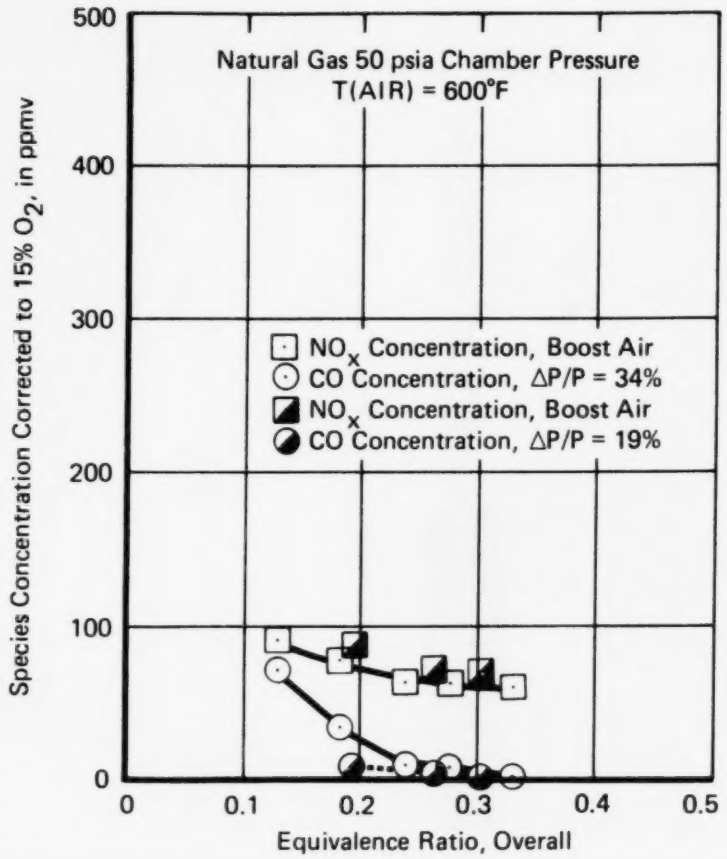


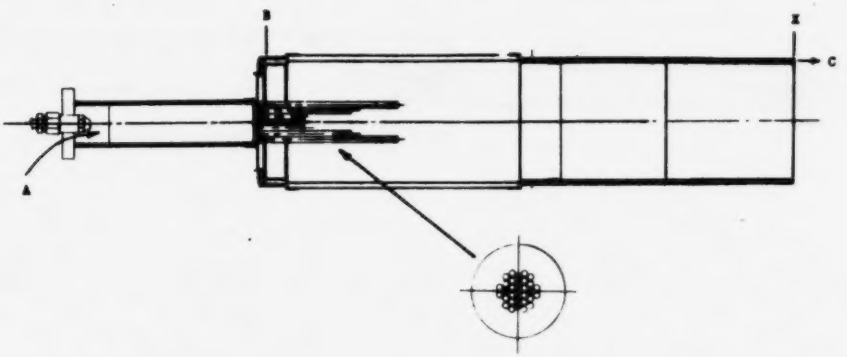
Figure 135. Reductions in NO_x Achieved With Concept No. 14, Boost-Air Dilution

3.3.16 Evaluation of Concept No. 16 — Extended Injector

Limited testing of the Extended Injector concept indicated that the exhaust emission concentration levels achievable were not better than those demonstrated with other flameholder designs. The design concept called for a perforated plate flameholder with tubular extension pieces on various holes, through which air or fuel-air mixture passed, to be discharged at various locations within the primary zone of the combustor. The experimental hardware used to evaluate this concept is shown in Figure 136. By varying the number and sizes of tubes, their routing and discharge points, broad range control of mixture and temperature profiles within the combustor could in principle be achieved.

Figure 136. Experimental Hardware Used in the Evaluation of Concept No. 16 — Extended Injector

Exploratory tests were conducted utilizing three configurations of the combustor involving slightly modified premix tube sections (Schemes 16-1A, 16-2A, and 16-3A, shown in Figures 137, 138, and 139). The extended injector tube configuration chosen provided for heating of the fuel-air mixture in the outermost tubes by the flame stabilized downstream of the shorter central tubes. The combustor was operated at fuel-lean primary zone equivalence ratios. Although significant reductions in NO_x were not demonstrated, this concept does offer an alternative to a very flexible flameholder design with many possible configurations that were not evaluated. With the success of Concept No. 29, Rich Burn/Quick Quench, the Extended Injector concept was retired.

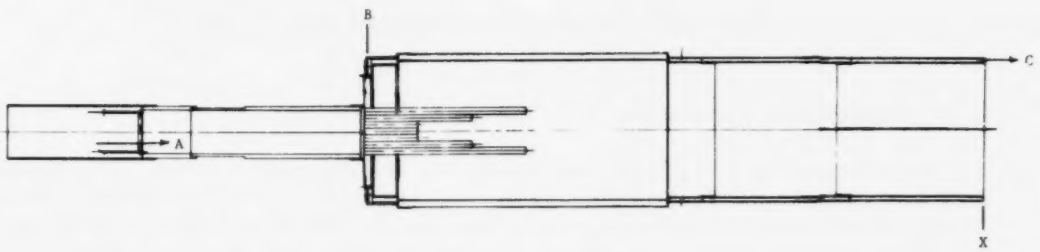


LB	AREF	L/D	VOLREF	ACDSUM
30.89	19.63	6.18	437.1	3.32

STATION	AX	ACD
A	2.221	0.625
B	19.079	0.0
C	19.079	1.187
X	113.040	1.311

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	5.00	0.95	0.0
BST2	14.60	2.78	0.0

Figure 137. Bench-Scale Combustor Scheme 16-1A

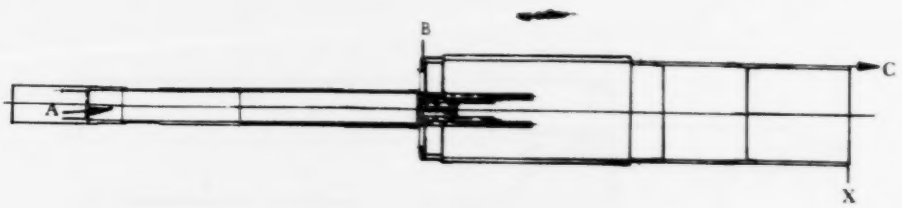


LB	AREF	L/D	VOLREF	ACDSUM
35.89	19.63	7.18	437.1	3.62

STATION	AX	ACD
A	2.221	0.825
B	19.079	0.0
C	19.079	1.187
X	113.040	1.606

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	10.00	0.95	0.0
BST2	19.60	2.78	0.0

Figure 138. Bench-Scale Combustor Scheme 16-2A



LB	AREF	L/D	VOLREF	ACDSUM
43.29	19.63	8.66	437.1	3.55

STATION	AX	ACD
A	2.221	0.825
B	19.079	0.0
C	19.079	1.187
X	113.040	1.533

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	18.00	0.95	0.0
BST2	26.90	2.78	0.0

Figure 139. Bench-Scale Combustor Scheme 16-3A

3.3.17 Evaluation of Concept No. 17 — Pebble Bed Combustor

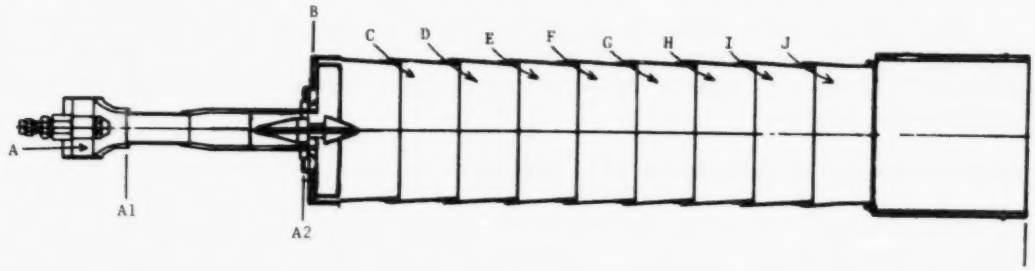
No evaluation of this concept was attempted. The approach calls for a side-mounted combustor (external to the gas turbine engine) having a low-velocity vertical discharge passage. Ceramic (or other material) pebbles are fed in near the exit, fall through the flame and remove heat. They are subsequently collected and recycled through a heat exchanger (where pebbles are cooled by inlet air) back into the combustor.

3.3.18 Evaluation of Concept No. 18 — Coanda Flame

Exploratory tests of a single configuration of the bench scale combustor (Scheme 18-1A, Figure 140) were conducted in the evaluation of the Coanda Flame concept. These tests were complementary to the investigation of the Low Intensity Flame concept reported in Section 3.3.1.

Scheme 18-1A represented another variation in the means of flameholding for burning within a central flame jet. This configuration consisted of a centerbody (identical to the one employed in Schemes 1-5A and 1-6A) and a rearward extension piece, attached to the centerbody, forming a groove for flame stabilization. The concept of stabilization employed in this design is that airflow streaming over the centerbody and extension piece can produce an eddy of recirculating flow and a region of reduced static pressure within the groove. If the airflow is premixed with fuel at mixture ratios within the limits of flammability, then the

recirculating flow can support continuous burning within the groove and can serve as a pilot for the mainstream mixture. The reduced static pressure within the groove serves to draw adjacent stream tubes onto the surface of the centerbody. The overall result is a low-drag flameholder potentially useful in piloting a flame within a high velocity jet. NO_x concentration data obtained for Scheme 18-1A were identical to those of Scheme 1-6A. This result may have been due in large part to the fact that the extension piece attached to centerbody was destroyed during the test, making the configuration exactly the same as that of Scheme 1-6A. No conclusion was drawn regarding the effectiveness of the Coanda flameholder.



LB	AREF	L/D	VOLREF	ACDSUM
33.25	19.63	6.65	490.8	4.54

STATION	AX	ACD
A	2.924	0.404
A1	0.828	0.0
A2	0.945	0.0
B	19.079	0.255
C	19.625	0.367
D	19.625	0.248
E	19.625	0.245
F	19.625	0.245
G	19.625	0.248
H	19.625	0.248
I	19.625	0.183
J	19.625	0.183
X	113.040	1.913

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST4	6.00	0.66	0.0
BST2	10.00	2.50	0.0
BST3	16.00	2.50	0.0

Figure 140. Bench-Scale Combustor Scheme 18-1A

3.3.19 Evaluation of Concept No. 19 — Electric Assist Nozzles

This concept had been identified as a potential area of investigation in order to provide for the selection of an electric assist nozzle in the event that an attractive candidate could be found in a survey of fuel injector manufacturers. Devices utilizing an applied electric field for atomization and subsequent controlled dispersion of droplets were envisioned. After a brief review, the concept was determined to be beyond the scope of the current program, because it appeared that extensive development would be required.

3.3.20 Evaluation of Concept No. 20 — Virtual Staging

No explicit investigation of the virtual staging concept was carried out. However, the principles involved were factored into the combustor designs used in the evaluations of other concepts. According to this concept, use can be made of the fact that burning zone volume increases (and the flame elongates) as combustor loading is increased (e.g., from idle to maximum power). By careful positioning of air entry holes in the combustor liner, the

flamefront originating in the primary zone can be made to grow into the additional airflow needed at maximum power, thereby providing automatic or "virtual" staging. Experience gained in the bench-scale program indicated that although virtual staging can provide a moderate degree of separation between zones, more positive control (such as that achievable with air staging or fuel staging) is also required to achieve the low NO_x and CO concentration levels specified in program goals.

3.3.21 Evaluation of Concept No. 21 — Engine Inlet Fuel Injection

This concept, which called for engine inlet injection and premixing of liquid fuel to achieve a very lean and uniform equivalence ratio at the inlet of the combustor (which would have been a catalytic or flameless combustion device) was determined to be beyond the scope of the current program.

...

3.3.22 Evaluation of Concept No. 22 — Flameless Combustion

The concept of flameless combustion, which postulated the careful application and control of heat from high temperature products of combustion to promote low-temperature, long residence-time flameless reactions (it was envisioned that nearly ideal premixing and prevaporization of liquid fuel, and a very large volume combustor would have been required to attain this mode of operation) was determined to be far beyond the current state-of-the-art in practical gas turbine combustion devices to warrant experimental evaluation is this program.

3.3.23 Evaluation of Concept No. 23 — Air Staging

To gain control of the physical and chemical processes of combustion for NO_x reduction, it is useful to vary the combustor internal airflow distribution. To accomplish this, variable geometry devices are usually proposed to apportion and regulate the airflow entering different sections of the combustor. Modular bench-scale hardware was constructed prior to the experimental program to provide off-on control of individual dilution air jets. The device selected, shown in Figure 141, utilized air-cylinder actuators that were operated by means of the pressure differential between the combustor compartment and the ambient environment external to the engine. In the course of the experimental program, there was no occasion to use this device in conjunction with other NO_x reduction concepts for the enhancement of NO_x control capability. In keeping with the general view that air staging is a secondary design concept, incapable of providing within itself the degree of control necessary to meet program NO_x and CO emission goals, the hardware shown was not tested.

An important application of air staging was demonstrated in conjunction with Concept No. 29, Rich Burn/Quick Quench, however. By valving the airflow supplied to the primary zone a constant stoichiometry was maintained, and it was possible to achieve a low NO_x concentration level at multiple engine operating conditions. A discussion of the air staging effects described is presented in Section 3.3.29.

3.3.24 Evaluation of Concept No. 24 — Fuel Staging

Fuel staging was included in the list of design concepts because it represents a major category of combustor variable zoning techniques. Fuel staging techniques were utilized in conjunction with a number of other design concepts, as indicated in Table IX. It was intended that further refinement of the methods of fuel staging employed might be undertaken if the test results indicated that more extensive development was required. Although considerable effort was devoted to improvements related to fuel staging provisions in the course of the experimental program, it was not necessary to isolate these for in-depth treatment as a separate design concept.

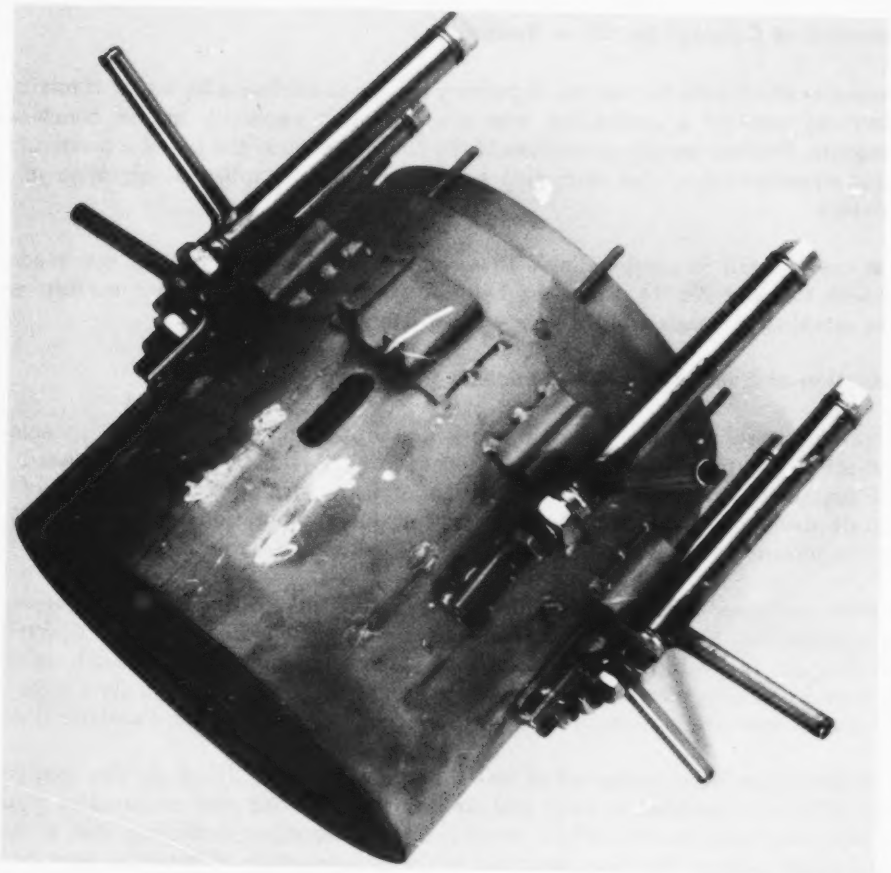


Figure 141. Air Staging Module Designed for Use in the Bench-Scale Combustor Program

TABLE IX
CONCEPTS INCORPORATING FUEL STAGING

Concept No. 1	— Low Intensity Flame	(Section 3.3.1)
Concept No. 4	— Superlean With Preburner	(Section 3.3.4)
Concept No. 5	— Heat Removal	(Section 3.3.5)
Concept No. 6	— Quench Reheat	(Section 3.3.6)
Concept No. 7	— Staged Centertube Burner	(Section 3.3.7)
Concept No. 11	— Distributed Flame	(Section 3.3.11)
Concept No. 28	— Rich Preburner	(Section 3.3.28)

3.3.25 Evaluation of Concept No. 25 — Vorbix

This concept, which calls for the use of swirling air jets to achieve a high rate of mixing in the main burning zone of a combustor, was not evaluated explicitly in the bench-scale screening program. Further specific provisions of the concept include the use of a preburner to promote rapid vaporization of the main fuel and to provide controlled autoignition of the resultant mixture.

Limited use of swirl in conjunction with secondary zone dilution air jets was made in conjunction with Concept No. 14, Boost-Air Dilution (Section 3.3.14), however no tests were conducted to establish a comparison to non-swirling jets as a baseline case.

3.3.26 Evaluation of Concept No. 26 — Fuel-Air Premixing

Much of the work conducted in conjunction with other design concepts to achieve uniform fuel-air premixing in lean-front-end burners was directed specifically toward the problems of premixing rather than the evaluation of lean burning. In recognition of the extensive effort devoted to this topic in the area of fuel preparation and in view of its fundamental importance, fuel-air premixing was identified as a separate design concept.

Tests were conducted of a particular fuel-air premixing device that showed promise for lean-burner applications. It had been suggested that this particular configuration (depicted in Figures 142 through 144) which consisted of an annular premixing chamber with an inlet swirler and four externally mounted fuel injectors, might serve as a backup device for the catalytic combustor evaluated in conjunction with Concept No. 2, Premixing Catalytic Burner.

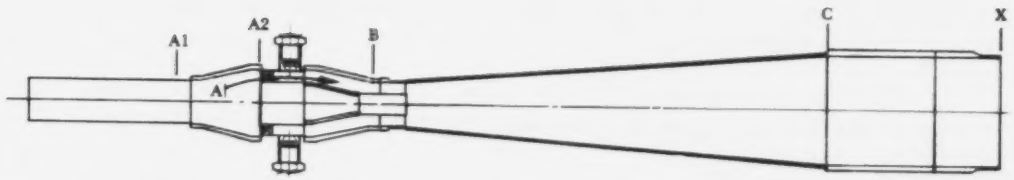
Tests of the device were conducted at 900°F and 50 psia using JP5 fuel. The configuration, Scheme 26-3A was operated at 0.021 fuel-air ratio setting, with very encouraging results. A very low NO_x concentration (12 PPMV, at 15% O_2) was recorded, indicating that a nearly homogenous fuel-air mixture had been provided in the primary zone of the combustor by the fuel-air premixing tube. (An appreciable degree of nonuniformity would have caused a sharp increase in NO_x, as a result of diffusion burning.) Visual observation of the burner during the tests also indicated that although the flame appeared to be piloted at an upstream location in the wake of the premixing passage, there was no glowing (heating) of the combustor liner at any point upstream of the joint between the conical diffuser and the five-inch diameter liner. This result seemed to indicate that the mixing-out of the very lean, piloted flame inside the combustor had been substantially completed within the conical transition piece, resulting in a very uniform fuel-air mixture at the entrance to the main combustor section. Altogether, these results indicated that a very homogenous lean fuel-air mixture can be achieved using the premix tube in question.

LB	AREF	L/D	VOLREF	ACDSUM
45.65	20.01	9.04	164.0	2.22

STATION	AX	ACD
A	6.739	1.569
B	6.739	0.0
C	18.611	0.0
D	19.996	0.0
X	113.040	0.646

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	8.00	1.50	0.0
BST2	14.00	1.80	0.0
BST3	26.00	2.00	0.0

Figure 142. Bench-Scale Combustor Scheme 26-1A



LB	AREF	L/D	VOLREF	ACDSUM
44.80	20.00	8.88	348.8	1.89

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.500
B	3.140	0.0
C	19.996	0.0
X	113.040	0.388

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	10.00	1.50	0.0
BST2	23.00	3.00	0.0
BST3	29.00	4.00	0.0

Figure 143. Bench-Scale Combustor Scheme 26-2A

LB	AREF	L/D	VOLREF	ACDSUM
44.80	20.00	8.68	348.8	2.11

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.500
B	3.140	0.0
C	19.996	0.0
X	113.040	0.606

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	10.00	1.50	0.0
BST2	23.00	3.00	0.0
BST3	29.00	4.00	0.0

Figure 144. Bench-Scale Combustor Scheme 26-3A

While the above results represent only those specifically designated at Concept No. 26, Fuel-Air Premixing, much work on premixing was embodied in the evaluation of other concepts. In general, the experience gained in fuel-air premixing may be summarized by the following comments:

1. Good premixing of fuel and air can be a valuable tool in achieving lower exhaust emissions.

2. Care must be exercised in the design of premixing devices to avoid preignition or flashback. Generally, the following design criteria were followed:

   - Passage velocities should be maintained sufficiently high to avoid flashback. This is particularly important for boundary layer considerations. If the mainstream average velocity is high, the velocity gradient of the boundary layer will be steep and will prevent the flame from propagating upstream through the boundary layer. A "rule-of-thumb" generated in this program was to maintain the average velocity above 200 fps.

   - In venturi passage designs (used to create high velocity for atomization purposes), a conservative diffuser should be used.

   - Residence time within the premixing passage (after fuel injection) should not be allowed to approach the autoignition time of the fuel. A large safety factor is usually advisable (>10) to account for unknowns in the boundary layer.

   - A clean aerodynamic design should be employed to prevent extended wakes or regions of separated or reversed flow.

3. While perfect fuel-air premixing (and prevaporization) is an ideal condition, it is possible to achieve excellent exhaust emissions in a practical system. It has been shown that when fuel, atomized to sufficiently small droplets, is reasonably well distributed through an airstream, residence time for vaporization to occur becomes less important.

3.3.27 Evaluation of Concept No. 27 — Refractory Block Flame Stabilizer

This concept, which was identified in the course of the experimental program, called for the use of a conically contoured combustor head plate made of ceramic material. Operation of the head plate at an elevated surface temperature was intended as a means of improving flame stability at ultralean primary zone equivalence ratios. No tests of the concept were conducted because of the initial success of the lean burning techniques employed in conjunction with Concept No. 7, Staged Centertube Combustor, and because of the subsequent program emphasis on rich burning in conjunction with Concept No. 29, Rich Burn/Quick Quench.

3.3.28 Evaluation of Concept No. 28 — Rich Preburner

Much of the development effort expended in the evolution of a basic rich front-end burner (in conjunction with Concept No. 5 - Heat Removal, and other concepts based on rich burning) can be classified as work leading to the demonstration of a successful rich preburner. Similarly much of the work conducted to achieve uniform fuel-air premixing in lean-front-end burners had been directed specifically toward the problems of Rich Preburner premixing rather than the evaluation of lean burning concepts. In recognition of the extensive effort devoted to this topic in the area of fuel preparation, and in view of its fundamental importance, Rich Preburner was identified as a separate design concept.

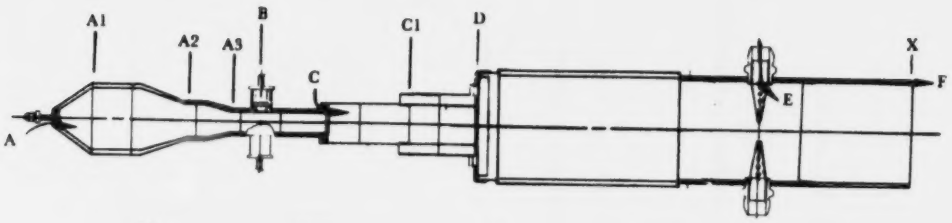
Subsequent to the specification of Concept No. 28 as a new area of investigation, the thrust of the experimental program shifted away from fuel preparation and was directed toward the evaluation of techniques for rapid dilution of primary zone products of combustion. Two test series were conducted, the first utilizing a basic rich preburner combustor modified to evaluate the concept of dilution air spraybars. Dilution air spraybars were a means of injecting airflow uniformly across the burner cross section to affect rapid dilution. These spraybars, shown in figure 145, were tapered, hollow "hats" directed radially inward with holes spaced and sized according to area. In the second test series, the preburner was removed, and natural gas firing of the same combustor was accomplished.

The initial series of tests was conducted to evaluate the effectiveness of dilution air spraybars as a means of achieving rapid mixing in rich-front-end combustors. A sufficiently high rate of mixing, if achieved in the dilution zone of a rich-front-end combustor, would allow the products of combustion from the primary zone to be diluted and cooled quickly enough to avoid the formation of appreciable thermal NO_x. In an attempt to achieve more rapid dilution, a system of spraybars was devised to disperse airflow uniformly over the cross-section of the dilution zone. Holes in the tube served to introduce the dilution airflow into the burner at multiple locations; the holes were sized in proportion to the local cross-sectional areas of adjacent regions of coverage inside the burner. The tubes were tapered to maintain a constant internal air velocity as airflow was discharged.

A photograph of the burner hardware is shown in Figure 145. As indicated, the spraybars were mounted in the position normally occupied by conventional dilution zone penetration air holes. In all other respects the combustor configuration, shown in Figure 146, was similar to previous configurations tested in the evaluation of rich-burning concepts.

The tests conducted with the dilution air spraybars were meant to provide a basis for comparing these devices to conventional dilution holes. Two configurations of the burner hardware (Schemes 28-1A and 28-2A, shown in Figures 146 and 147) differing only in the amount of dome cooling airflow were evaluated. Data obtained are shown in Figure 148. While the CO data for both schemes fell on the same curve, there were significant differences in NO_x concentration levels. Increased dome cooling (3.7 percent vs 0 percent) caused a reduction in the peak NO_x concentrations measured.

Figure 145. Experimental Hardware (Dilution Air Spraybar Module) Used in the Evaluation of Concept No. 28 — Rich Preburner

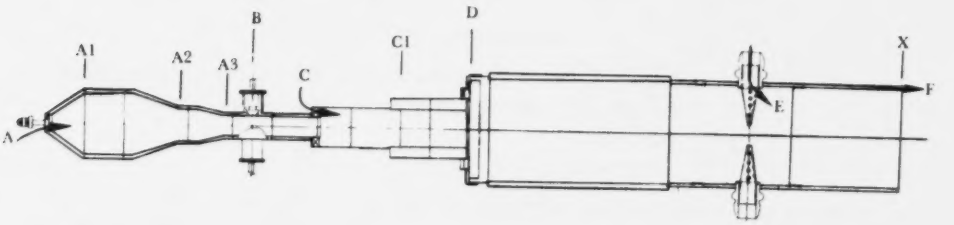


LB	AREF	L/D	VOLREF	ACDSUM
41.88	19.63	8.37	417.1	4.38

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	2.909	0.0
D	19.079	0.162
E	19.079	1.178
F	19.079	0.451
X	113.040	2.070

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.75	0.0
BST2	12.50	0.66	0.0
BST3	16.00	1.00	0.0
BST4	22.60	2.81	0.0

Figure 146. Bench-Scale Combustor Scheme 28-1A



LB	AREF	L/D	VOLREF	ACDSUM
41.88	19.63	8.37	417.1	3.75

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	2.909	0.0
D	19.079	0.0
E	19.079	1.178
F	19.079	0.451
X	113.040	1.604

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.75	0.0
BST2	12.50	0.66	0.0
BST3	16.00	1.00	0.0
BST4	22.60	2.81	0.0

Figure 147. Bench-Scale Combustor Scheme 28-2A

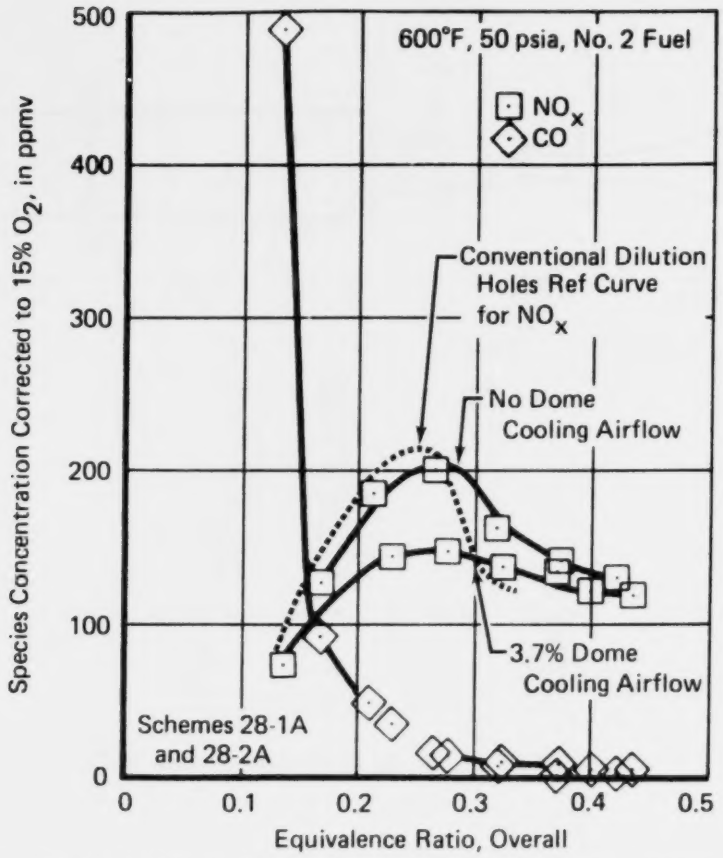
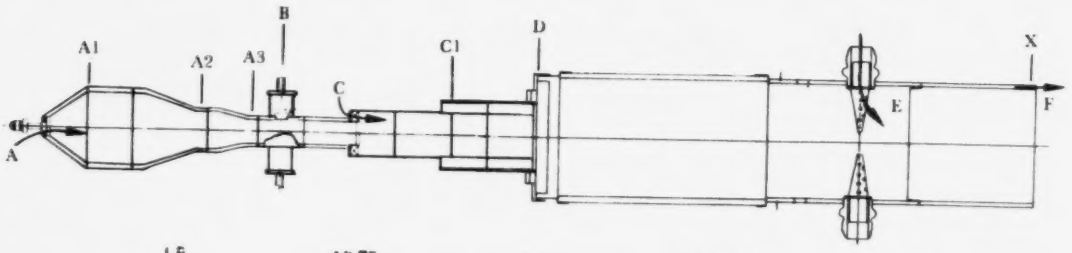


Figure 148. Variation in Species Concentration With Equivalence Ratio for Concept No. 28 (Rich Preburner) With Dilution Air Spraybars

The dashed curve included for reference in Figure 148 represents NO_x data taken in a similar rich-front-end burner with conventionnal dilution zone penetration air holes. A comparison of the dashed curve to the NO_x data points obtained in the configuration with no dome cooling, shows the following result. While the peak concentrations in the two curves very nearly coincide, the curve for dilution air spraybars does not drop off as rapidly on the right side of the peak. This result, indicating that more NO_x was formed at the higher equivalence ratio points with dilution air spraybars, is the opposite of the desired effect. If the influence of the spraybars is assumed to be confined to the dilution zone (as presumably it must be), then it can be concluded that the added increment of NO_x measured with spraybars was formed in the dilution zone of the burner. Although this conclusion may at first appear inconsistent with the presumption that more rapid mixing is offered by the spraybars, there is a potential explanation. NO_x formation may have occurred in the dilution zone primarily because of ineffective jet penetration and relatively slow mixing of the dilution flow with the mainstream. This would allow more time at higher temperatures which are favorable for NO_x formation. Upon further consideration it might also be reasoned that an inappropriate transition was effected. A proper transition might require physical separation between zones great enough to isolate the processes occurring in each. A much more effective transition was ultimately found in the reduced cross-sectional area configuration successfully employed in Concept No. 29, Rich Burn/Quick Quench, which is described in the next section.

Further tests with dilution air spraybars were conducted in which the orientation of the air jets was varied from downstream directed to upstream directed. Baseline tests were also conducted in which conventional slotted and round wall jets were evaluated. The combustor configurations tested, Schemes 28-3A through 28-7A are shown in Figures 149 through 153. The majority of these tests were conducted firing natural gas in order to remove any influence of variations in fuel prevaporization on the test results. It was concluded from the experiments performed that there was no evident advantage noted in using dilution air spraybar devices in place of conventional dilution holes in the basic rich-front-end combustor evaluated.

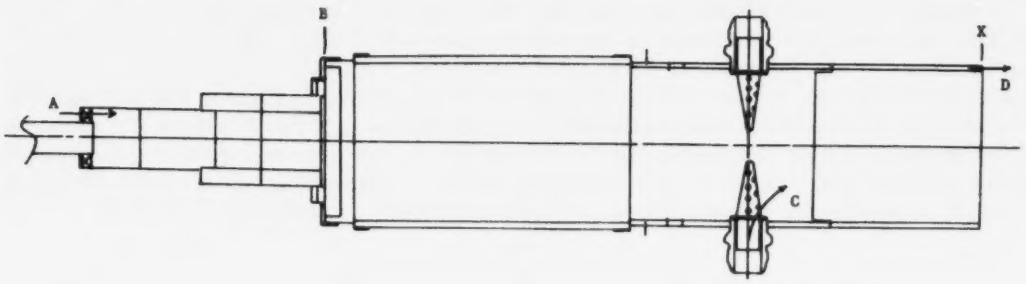


LB	AREF	L/D	VOLREF	ACDSUM
41.66	19.63	6.37	417.1	4.09

STATION	AX	ACD
A	0.502	0.017
A1	7.389	0.0
A2	2.035	0.0
A3	0.864	0.0
B	0.864	0.0
C	2.924	0.500
C1	2.909	0.0
D	19.079	0.0
E	19.079	1.178
F	19.079	0.451
X	113.040	1.941

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.75	0.0
BST2	12.50	0.66	0.0
BST3	19.00	1.50	0.0
BST4	22.00	2.76	0.0

Figure 149. Bench-Scale Combustor Scheme 28-3A

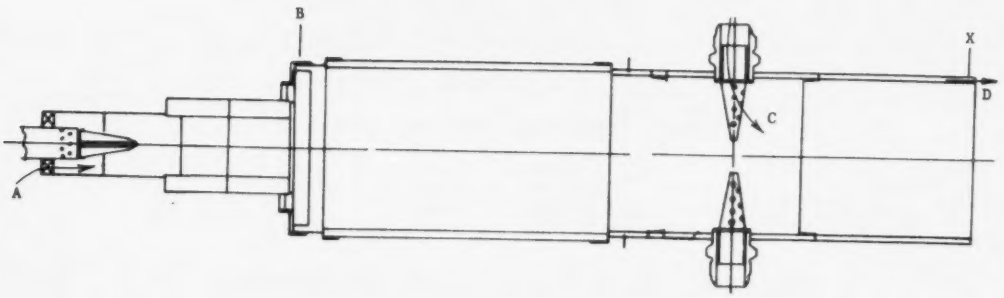


LB	AREF	L/D	VOLREF	ACDSUM
28.36	19.09	5.75	405.7	4.24

STATION	AX	ACD
A	2.924	0.500
B	19.079	0.0
C	19.079	1.294
D	19.079	0.451
X	113.040	1.996

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	2.50	1.00	0.0
BST2	6.00	1.50	0.0
BST3	13.10	2.78	0.0

Figure 150. Bench-Scale Combustor Scheme 28-4A

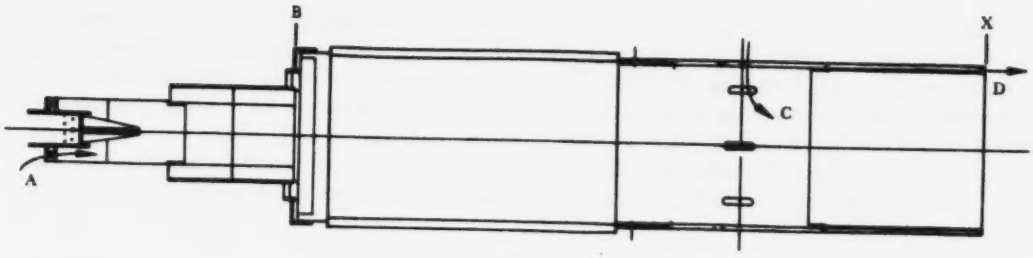


LB	AREF	L/D	VOLREF	ACDSUM
28.38	19.63	5.68	417.1	4.35

STATION	AX	ACD
A	2.924	0.500
B	19.079	0.0
C	19.079	1.294
D	19.079	0.451
X	113.040	2.105

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	2.50	1.00	0.0
BST2	6.00	1.50	0.0
BST3	13.10	2.78	0.0

Figure 151. Bench-Scale Combustor Scheme 28-5A

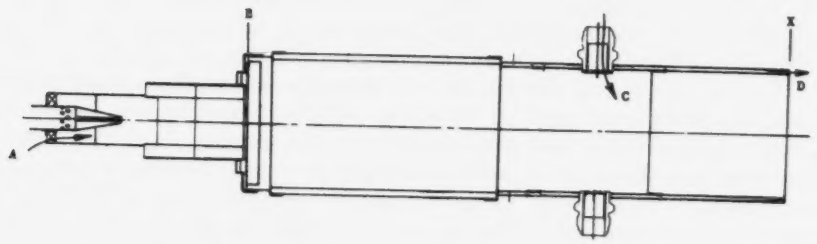


LB	AREF	L/D	VOLREF	ACDSUM
29.39	19.63	5.88	437.1	4.68

STATION	AX	ACD
A	2.924	0.500
B	19.079	0.0
C	19.079	1.251
D	19.079	0.997
X	113.040	1.926

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	2.50	1.00	0.0
BST2	6.00	1.50	0.0
BST3	13.10	2.78	0.0

Figure 152. Bench-Scale Combustor Scheme 28-6A



LB	AREF	L/D	VOLREF	ACDSUM
28.38	19.63	5.68	417.1	4.11

STATION	AX	ACD
A	2.924	0.500
B	19.079	0.0
C	19.079	0.974
D	19.079	0.451
X	113.040	2.185

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	2.50	1.00	0.0
BST2	6.00	1.50	0.0
BST3	13.10	2.78	0.0

Figure 153. Bench-Scale Combustor Scheme 28-7A

3.3.29 Evaluation of Concept No. 29 — Rich Burn/Quick Quench

The design concept employed in this rich burning investigation did not correspond exactly to any of the other 28 candidate design concepts previously identified in Phase I or in the bench-scale testing program of Phase II. A unique description of the approach taken was established by designating it as a separate design concept. Concept No. 29 — Rich Burn/Quick Quench — was selected as the title for the concept. Because of the initial success of this particular approach to NO_x reduction, the Rich Burn/Quick Quench combustion concept was not only selected as a primary design concept, but was subsequently subjected to further, more detailed parameter evaluation.

Reference is made to the description of prior tests involving Concept No. 6 (Quench-Reheat) presented in Section 3.3.6 of this report. In those tests it had been found that concurrently low concentrations of NO_x and CO could be achieved by setting up a rich primary zone in combination with a dilution zone of rapid flame-quenching ability.

a. Initial Tests

In Concept No. 6, Quench Reheat, four key elements were associated with the success of the concept: (1) fuel-air premixing; (2) fuel-rich operation within the primary combustion volume; (3) rapid secondary air flame quenching; and (4) reheating of the fuel-lean secondary zone gases with a small pilot burner. It had been found that the reheat burner was counterproductive in that NO_x increased significantly when the reheat burner was used compared to when it was not used. It was also found, when the reheat burner was not used, a single point remained where values of NO_x and CO were simultaneously low.

Under Concept No. 29 a configuration was proposed that was essentially identical to the Concept No. 6 configuration, with the exception that provisions for liquid fuel operation were made (the tests of Concept No. 6 had been conducted using natural gas), and that the aft section of the Concept 6 burners, which had contained a side-mounted pilot-burner module (for reheating purposes), was removed. The configuration is schematically represented in Figure 154. Several variations of this basic configuration were tested initially (see Figures 155 through 161). Typical test results (see Figure 162) showed that with fuels containing nitrogen, NO_x concentration levels were high at idle-range values of the overall equivalence ratio (because of local mixture ratios near stoichiometric in the primary zone); but that very low concentration levels were measured at intermediate-range values (because of fuel-rich burning in the primary zone). At high-range values of overall equivalence ratio, NO_x concentration levels were again high, perhaps due to the appearance of fuel nitrogen species in the secondary zone. These results characterized the initial burner configuration as having a single design point for low NO_x as predicted from the results of Concept No. 6. However, for fuels without appreciable nitrogen, it was observed that NO_x remained low at the high operating conditions.

In the initial test series, concentrations as low as 34 ppmv NO_x (corrected to 15% O_2) were measured at the design point operating equivalence ratio using No. 2 distillate fuel oil with 0.5% chemically bound nitrogen (in the form of pyridine). These results, obtained at 50 psia and 600°F, were considered very promising and indicated that the program goal of 100 ppmv (for fuels with bound nitrogen) could be met.

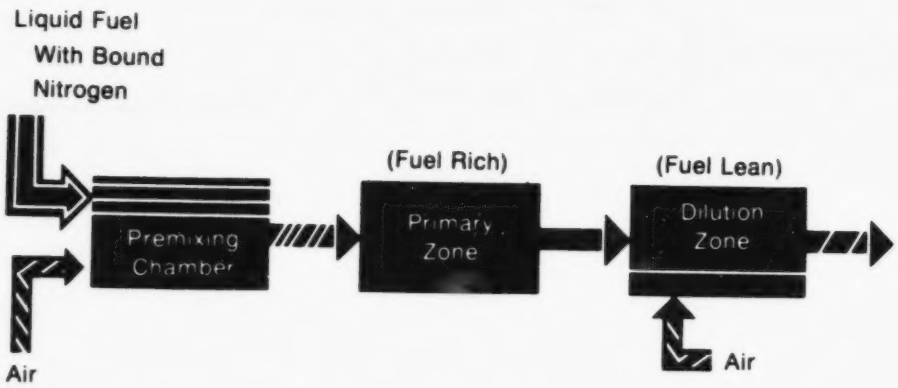
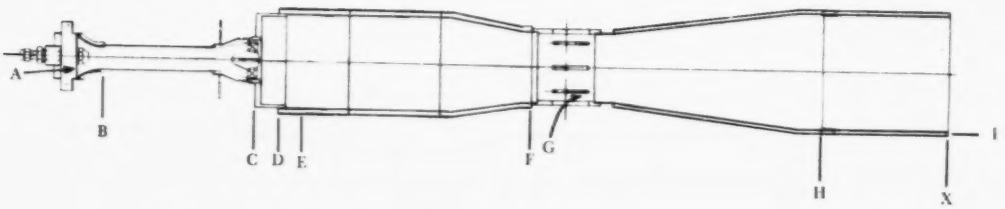


Figure 154. Component Diagram of Rich Burning Concept

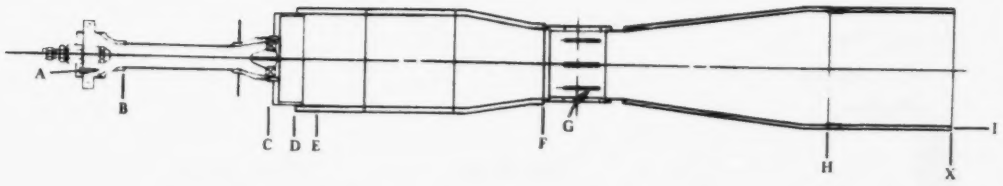


LO	AREF	L/D	VOLREF	ACDSUM
39.81	19.63	7.96	518.8	3.46

STATION	AX	ACD
A	2.924	0.440
B	0.826	0.0
C	2.924	0.0
D	12.424	0.0
E	12.724	0.0
F	7.539	0.0
G	7.589	1.591
H	19.079	0.0
I	19.079	0.700
X	113.040	0.950

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
DST1	3.00	0.56	0.0
DST2	13.20	2.25	0.0
DST3	18.20	2.25	0.0

Figure 155. Bench-Scale Combustor Scheme 29-1A

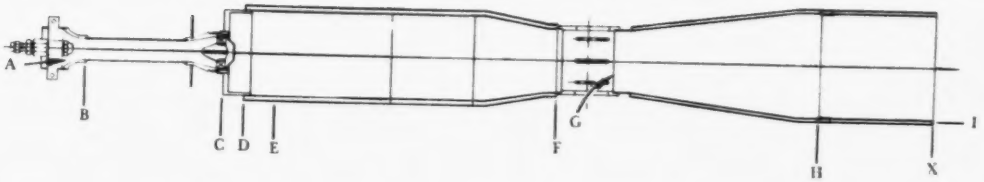


LB	AREF	L/D	VOLREF	ACDSUM
37.01	19.63	7.56	301.9	3.63

STATION	AX	ACD
A	2.924	0.270
B	3.628	0.0
C	4.924	0.0
D	12.724	0.0
E	14.724	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.271

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	13.20	2.25	0.0
BST3	16.20	2.25	0.0

Figure 156. Bench-Scale Combustor Scheme 29-2A

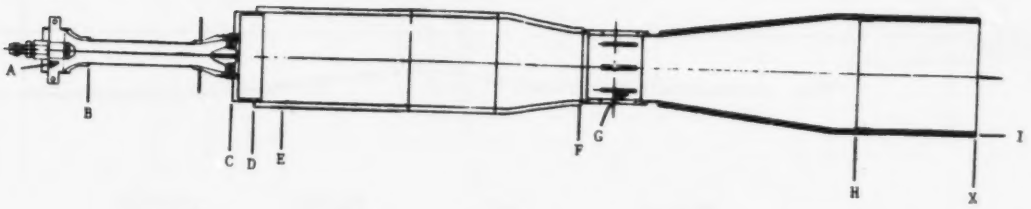


LB	AREF	L/D	VOLREF	ACDSUM
42.01	19.63	8.56	365.6	3.49

STATION	AX	ACD
A	2.924	0.270
B	3.628	0.0
C	4.924	0.0
D	12.724	0.0
E	14.724	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.140

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	13.00	2.25	0.0
BST3	21.20	2.25	0.0

Figure 157. Bench-Scale Combustor Scheme 29-3A

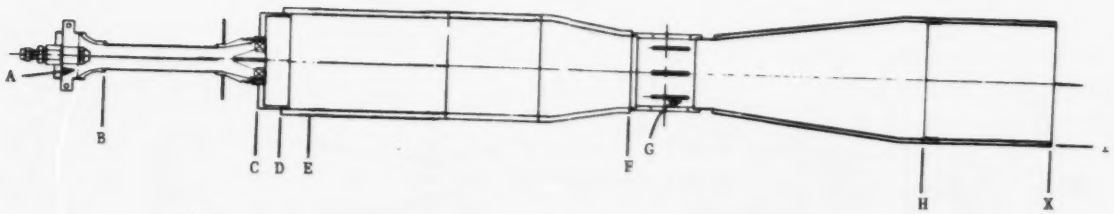


LB	AREF	L/D	VOLREF	ACDSUM
42.81	19.63	8.56	365.6	3.96

STATION	AX	ACD
A	2.924	0.569
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	12.724	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.430

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	13.00	2.25	0.0
BST3	21.20	2.25	0.0

Figure 158. Bench-Scale Combustor Scheme 29-4A

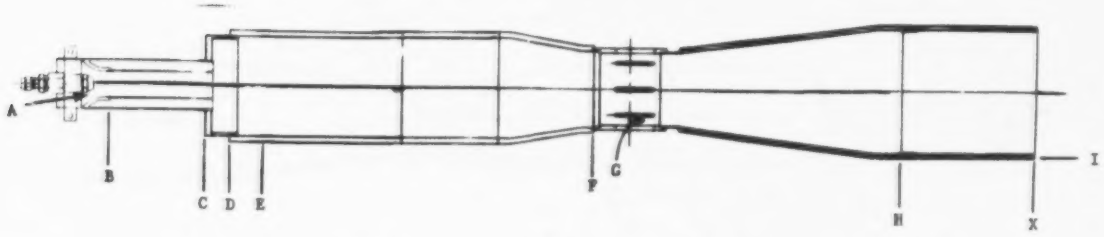


LB	AREF	L/D	VOLREF	ACDSUM
42.81	19.63	8.56	365.6	3.70

STATION	AX	ACD
A	2.924	0.569
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	12.724	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.051

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	13.00	2.25	0.0
BST3	21.20	2.25	0.0

Figure 159. Bench-Scale Combustor Scheme 29-6A

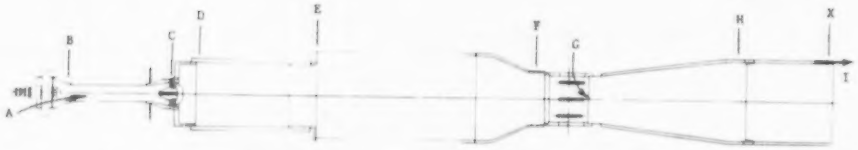


Lb	AREF	L/D	VOLREF	ACDSUM
40.74	19.63	8.15	365.6	3.99

STATION	AX	ACD
A	2.924	0.746
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	12.724	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.166

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.00	0.0
BST2	11.00	2.25	0.0
BST3	19.20	2.25	0.0

Figure 160. Bench-Scale Combustor Scheme 29-7A



Lb	AREF	L/D	VOLREF	ACDSUM
51.01	19.63	10.30	623.44	3.91

STATION	AX	ACD
A	2.924	0.746
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	22.039	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.166

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	14.00	2.25	0.0
BST3	21.50	2.76	0.0

Figure 161. Bench-Scale Combustor Scheme 29-8A

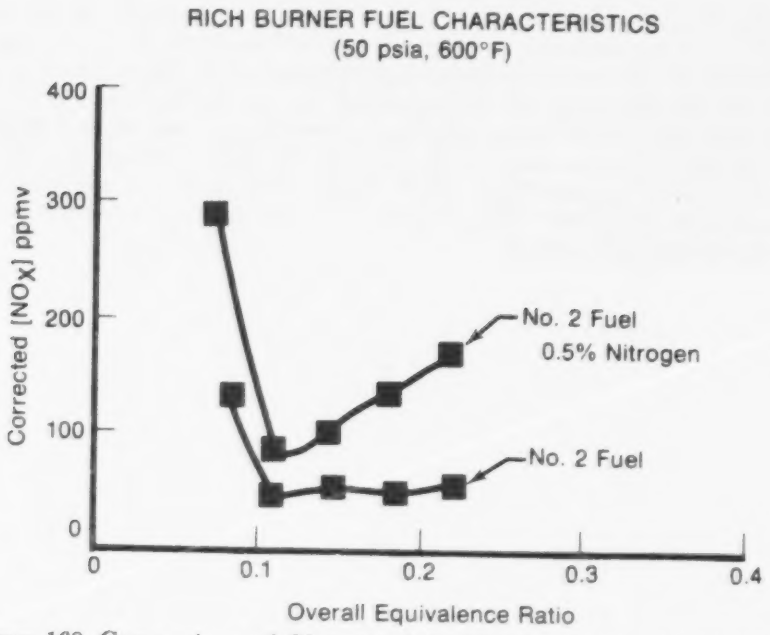


Figure 162. Comparison of Characteristic NO_x Emission Signatures for Heat No. 2 Fuel and the Same Containing 0.5% Chemically-Bound Nitrogen

b. Basic Emission Characteristics

In the course of the initial evaluation of Concept No. 29, a basic understanding of the factors responsible for the success of the concept began to emerge. The title, "Rich Burn/Quick Quench," described the intended approach to NO_x reduction embodied in this concept. Consecutive zones of: (1) rich burning (to suppress the formation of NO_x by virtue of a low flame temperature and a low concentration of available oxygen); and (2) very rapid dilution were established within the burner. The rich-burning zone was supplied with a mixture of fuel and air of sufficient homogeneity to ensure that the bulk of the combustion process would actually take place at locally fuel-rich conditions (lack of homogeneity results in diffusion burning, which takes place largely at near-stoichiometric conditions). The requirement for homogeneity was satisfied by the use of a premixing passage, and by the elimination from the rich-burning zone of any source of airflow other than that entering from the premixing passage. The dilution zone featured a quick-quench device (dilution holes in a reduced diameter section) that introduced excess air and caused it to mix rapidly, resulting in a near step change in the mixture composition (from fuel-rich to fuel-lean). If the change in mixture composition had been allowed to take place slowly, diffusion burning (at near-stoichiometric conditions) would have predominated, resulting in high thermal NO_x concentrations. In designing the quick-quench device, a high mainstream velocity was maintained, making it difficult for flameholding to occur in the wakes of the dilution air jets. A small-angle conical diffuser downstream of the dilution slots was also provided, precluding the possibility of flow separation and flameholding within the associated reverse-flow regions. While these were the initial considerations used to design the quick quench zone, it was later determined that round holes functioned as well as the slots, and that by providing a dump in place of the diffuser, no significant increase in NO_x was found. It was also discovered later, that a passage of reduced cross section in which a substantial mass addition momentum pressure loss occurs, may provide very effective separation of the fuel-rich and fuel-lean process within each zone; and ultimately aid in making the near step transition in composition and temperature resulting in lower NO_x emissions.

The rich-burner (Rich Burn/Quick Quench) arrangement is shown in Figure 163. A typical configuration of the experimental hardware is shown in Figure 164. The basic emission characteristics of the Rich Burn/Quick Quench concept are presented in Figure 165. Curves for NO_x and CO are shown, plotted against the burner overall (exit plane) equivalence ratio. The curve for UHC has been omitted for clarity; all UHC concentrations were below 5 ppmv for these tests and for the other tests described in this section. The data presented in Figure 165 were generated by holding the burner airflow nearly constant and by varying the burner fuel flowrate to achieve different equivalence ratio settings. An explanation of the features of these curves is given in the following paragraphs.

Figure 163. Typical Rich Burn/Quick Quench Arrangement

Figure 164. Typical Bench-Scale Rich Burn/Quick Quench Combustor Hardware

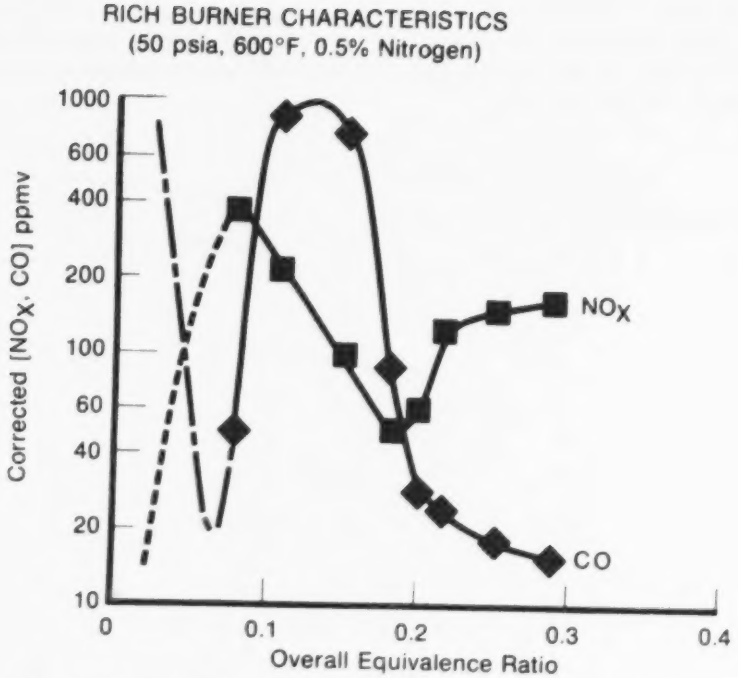
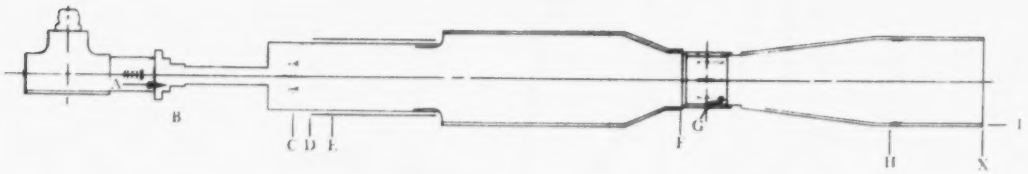


Figure 165. NO_x and CO Emission Signatures for the Rich Burn/Quick Quench Combustor Concept at Low Power Setting (0.5% Fuel Nitrogen, Scheme 29-8A)

Attention is directed to the CO curve, which exhibits a strong central peak, and to the NO_x curve, which has a centrally located "bucket" or minimum concentration. These features are the expected results of: (1) the quenching of combustion gases (to produce a high concentration of CO) by airflow entering through the quick quench section; and (2) the rich-burning process (which minimizes the formation of NO_x from both thermal and fuel nitrogen sources) that takes place in the primary zone. The surprising result in these data is that the CO peak and the NO_x bucket do not coincide (i.e., do not occur at the same value of overall equivalence ratio). This means that a low-NO_x operating point can be found that does not have a concurrently high concentration of CO. The data in Figure 165 indicate that this point occurs at 0.18 equivalence ratio for the particular combustor Scheme (29-8A) represented. Concentrations of about 50 ppmv NO_x and 50 ppmv CO (both at 15% O_2) are indicated, at the stated conditions of 50 psia and 600°F, using No. 2 fuel with 0.5% fuel nitrogen. These values were well below the program goals of 100 ppmv CO and 100 ppmv NO_x.

While the initial tests showed very encouraging results, the limitation of a single low NO_x design point was considered undesirable for application in a gas turbine engine because of the range of operating conditions that must be covered. The low NO_x operating point in Figure 165 occurs at an equivalence ratio well below the combustor design-point value of 0.3. In numerous tests, it became apparent that the NO_x "bucket" could not be broadened to cover a wide range on the overall equivalence ratio scale. The bench-scale screening efforts were therefore directed toward exploring techniques for achieving low NO_x over a range of operating conditions. It was reasoned that in order to achieve low concentration values of NO_x, fuel-rich burning conditions must be maintained in the primary zone at all operating points. By varying the quantity of airflow admitted into the primary zone in proportion to the quantity of fuel, stoichiometry within the primary zone could be controlled over a range of operating conditions.

Therefore, the Rich Burn/Quick Quench concept was combined with Concept No. 23, Air Staging, in an attempt to demonstrate control over primary zone stoichiometry and evaluate the effects on exhaust emissions. Air staging was accomplished using an externally mounted air valve fitted to the inlet of the fuel-air premix tube. Several configurations were tested, as depicted in Figures 166 through 175.

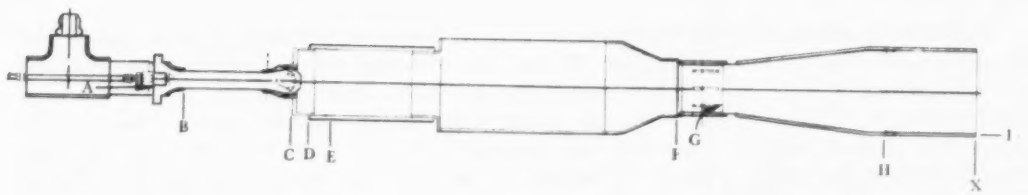


LC	AREF	L/D	VOLREF	ACDSUM
21.81	19.63	10.36	623.2	4.24

STATION	AX	ACD
A	2.924	0.271
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	22.509	0.0
F	7.389	0.0
G	7.389	3.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.291

MEMBER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	14.00	2.25	0.0
BST3	21.50	2.78	0.0

Figure 166. Bench-Scale Combustor Scheme 29-9A

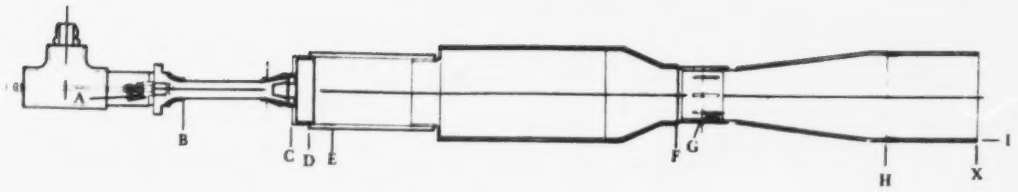


LC	AREF	L/D	VOLREF	ACDSUM
21.81	19.63	10.36	623.2	3.56

STATION	AX	ACD
A	2.924	0.276
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	22.509	0.0
F	7.389	0.0
G	7.389	3.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.099

MEMBER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	14.00	2.25	0.0
BST4	21.50	2.78	0.0

Figure 167. Bench-Scale Combustor Scheme 29-10A



LB	AREF	L/D	VOLREF	ACDSUM
51.81	19.63	10.36	623.2	4.06

STATION	AX	ACD
A	2.924	0.606
B	0.826	0.0
C	2.924	0.0
D	12.724	0.0
E	22.609	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.366

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	14.00	2.25	0.0
BST4	21.50	2.78	0.0

Figure 168. Bench-Scale Combustor Scheme 29-11A

LB	AREF	L/D	VOLREF	ACDSUM
46.91	19.63	9.78	645.9	3.83

STATION	AX	ACD
A	2.924	0.507
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	1.239

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	13.00	2.78	0.0
BST4	23.00	2.78	0.0

Figure 169. Bench-Scale Combustor Scheme 29-12A

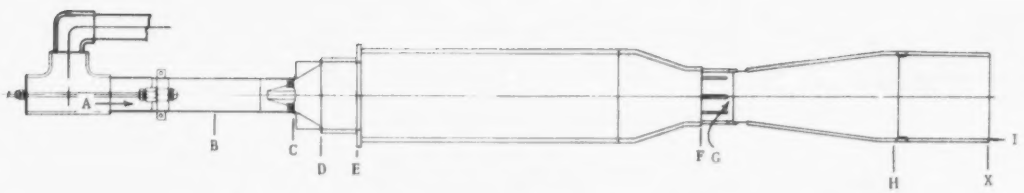
Reproduced from
best available copy.

LE	AREF	L/D	VOLREF	ACDSUM
49.625	19.63	9.85	645.4	3.37

STATION	AX	ACL
A	2.924	0.499
B	2.924	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	0.780

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	13.00	1.00	0.0
BST4	18.00	2.78	0.0

Figure 170. Bench-Scale Combustor Scheme 29-13A

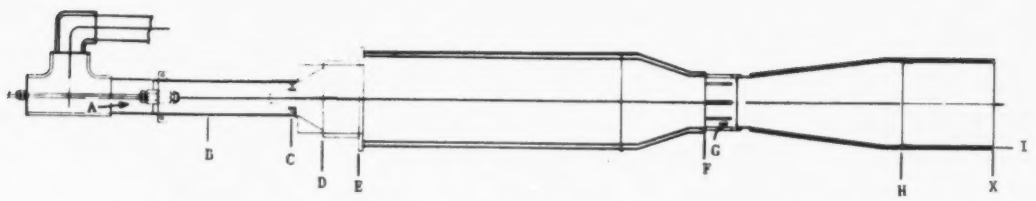


LB	AREF	L/D	VOLREF	ACDSUM
49.625	19.63	9.85	645.9	3.63

STATION	AX	ACL
A	2.924	0.499
B	2.924	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	0.780

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	13.00	1.00	0.0
BST4	18.00	2.78	0.0

Figure 171. Bench-Scale Combustor Scheme 29-14A

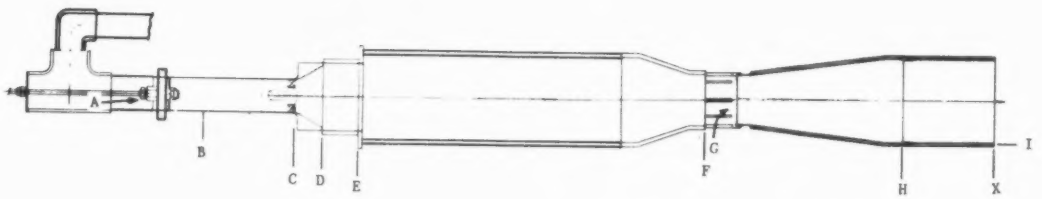


LB	AREF	L/D	VOLREF	ACDSUM
49.25	19.63	9.85	645.9	3.25

STATION	AX	ACD
A	2.924	1.104
B	2.924	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.917
H	19.079	0.0
I	19.079	0.700
X	113.040	0.529

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	13.00	1.00	0.0
BST4	18.00	2.76	0.0

Figure 172. Bench-Scale Combustor Scheme 29-15A

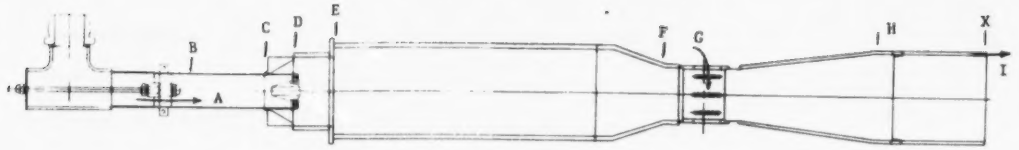


LB	AREF	L/D	VOLREF	ACDSUM
50.05	19.63	10.01	652.6	3.15

STATION	AX	ACD
A	2.924	1.104
B	2.924	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.954
H	19.079	0.0
I	19.079	0.700
X	113.040	0.397

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	13.00	1.00	0.0
BST4	18.00	2.78	0.0

Figure 173. Bench-Scale Combustor Scheme 29-16A



LB	AREF	L/D	VOLREF	ACDSUM
46.55	19.63	9.71	652.6	3.53

STATION	AX	ACD
A	2.924	1.119
B	2.924	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	0.331

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	1.00	0.0
BST3	0.0	0.0	0.0
BST4	11.00	2.78	0.0

Figure 174. Bench-Scale Combustor Scheme 29-17A

LB	AREF	L/D	VOLREF	ACDSUM
51.65	19.63	10.33	652.6	3.52

STATION	AX	ACD
A	2.924	1.026
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	1.381
H	19.079	0.0
I	19.079	0.700
X	113.040	0.412

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	14.10	2.78	0.0
BST4	20.10	2.78	0.0

Figure 175. Bench-Scale Combustor Scheme 29-18A

By varying the quantity of air admitted to the primary zone, it was found that the position of the "bucket" could be shifted. For example, by increasing the primary zone airflow from 10% (the value represented in Figure 165) to 20%, it was possible to shift the NO_x "bucket" from 0.18 to 0.28 on the equivalence ratio scale. These data are shown in Figure 176. Again, one of the more northworthy features of the results is the fact that the position of the CO curve did not change the NO_x bucket was shifted. This meant that separate control of the NO_x curve has been demonstrated in these tests. By staging the amount of airflow that enters the primary zone through the premix tube (in effect, by shifting airflow from the dilution zone to the premix tube and back), it was possible to achieve a low NO_x concentration at any value of overall equivalence ratio between 0.18 and 0.28, with essentially no change in CO emissions near the NO_x bucket. This is illustrated in Figure 177 as low NO_x corridor covering the range of operating equivalence ratios.

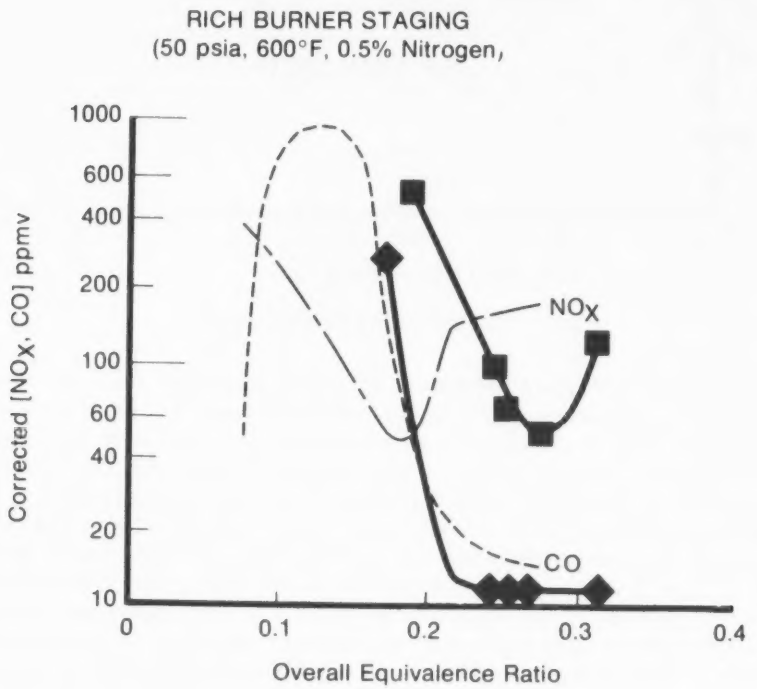


Figure 176. NO_x and CO Emission Signatures for the Rich Burn/Quick Quench Combustor Concept at High Power Setting (0.5% Fuel Nitrogen, Scheme 29-9A)

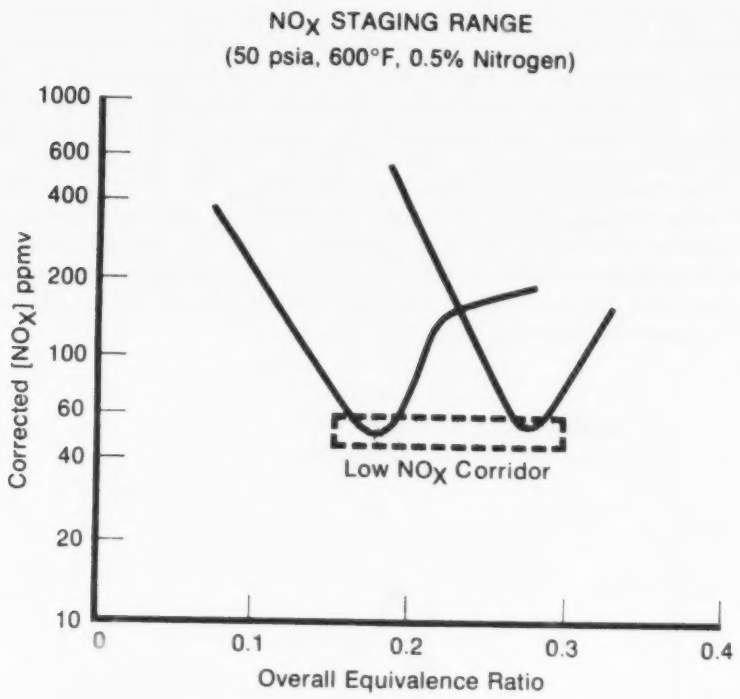


Figure 177. NO_x Staging Capability

This phenomenon is further illustrated by plotting exhaust emission concentrations against primary zone equivalence ratio. This is shown for Scheme 29-19A in Figure 178. It can be seen in this figure that as the primary zone airflow is increased from a low valve (9.8%) through an intermediate value (13.5%) to a high setting (21.4%), the NO_x emissions remain fixed. A large change in the CO is noticed instead. What this actually means is, as a larger quantity of airflow is admitted to the primary zone, a proportionately larger quantity of fuel is required to achieve the same primary zone equivalence ratio. Since the quick quench airflow remains nearly the same (for the same pressure drop), the higher fuel flow translates into a higher equivalence ratio within the secondary zone. This in turn causes the temperatures of the secondary zone gases to rise and ultimately leads to decreased CO concentrations. The need to maintain a high enough temperature within the secondary zone is self-evident. In practice, this would either require the use of final dilution airflow (to allow higher temperatures initially in the secondary zone) or a means of varying the quick quench airflow.

Two other significant results were also evident from the initial bench-scale evaluation of the Rich Burn/Quick Quench concept. In Figure 179, data recorded at 150 psia rig pressure are presented which indicate that there is virtually no increase in the level of the NO_x concentration measured at the bottom of the NO_x "bucket," compared to the level previously obtained at 50 psia. This lack of a pressure effect for NO_x is strong evidence of the fact that the primary-zone combustion process had taken place predominantly under locally fuel-rich conditions. At the same time however, CO concentrations at 150 psia were markedly lower than at 50 psia. The effect of increased inlet-air temperature is also hinted at in Figure 179. The minimum NO_x concentration achieved at 750°F inlet-air temperature was only 10 ppmv higher (60 ppmv vs 50 ppmv) than the one measured at 650°F. Although these data were recorded at two different primary airflow settings, there is no reason to believe that this difference would affect the minimum NO_x concentration level (in Figure 176, it was shown that there is no effect of staging on the minimum NO_x concentration level).

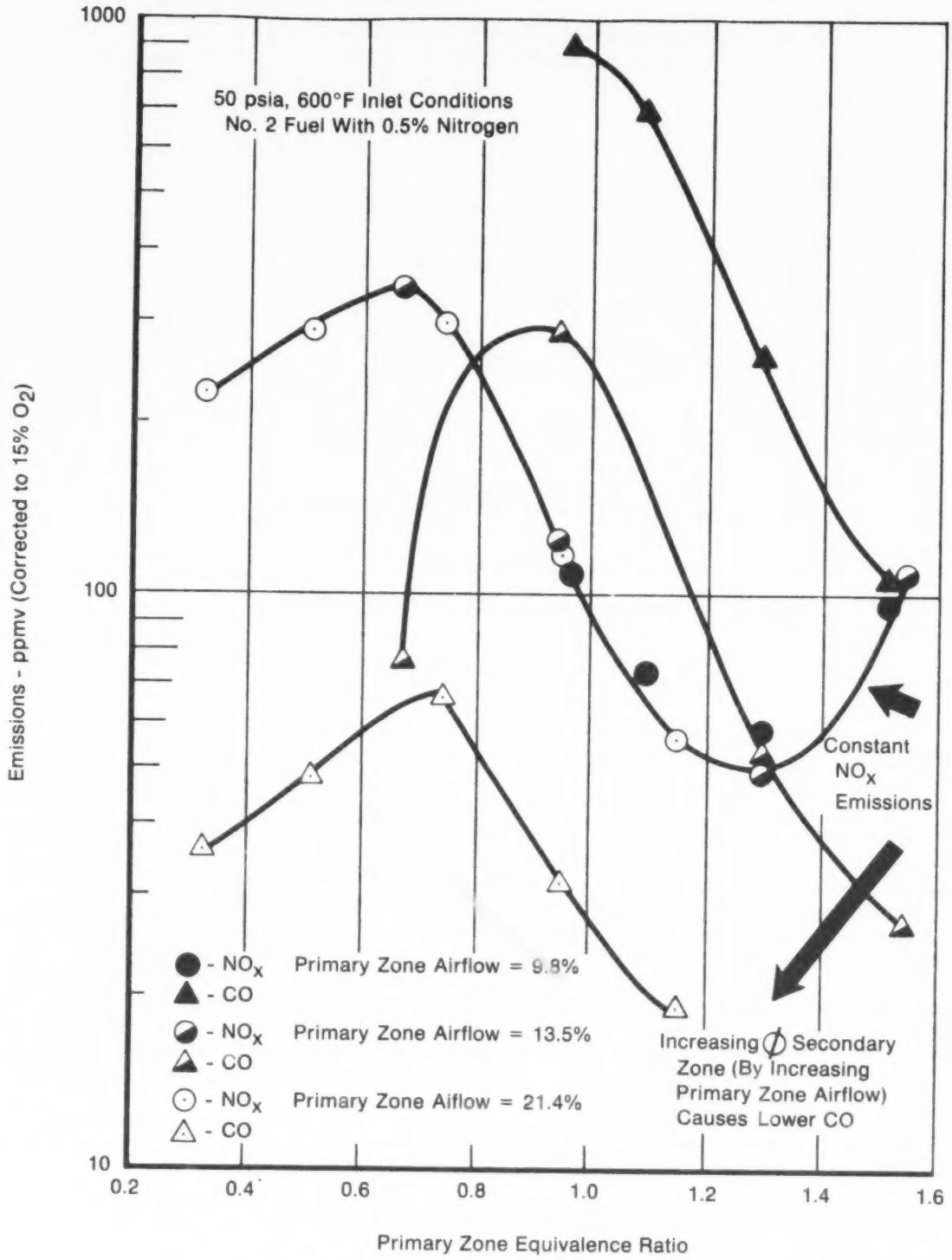


Figure 178. Effect of Primary Zone Airflow Staging on NO_x and CO Emissions (Scheme 29-19A)

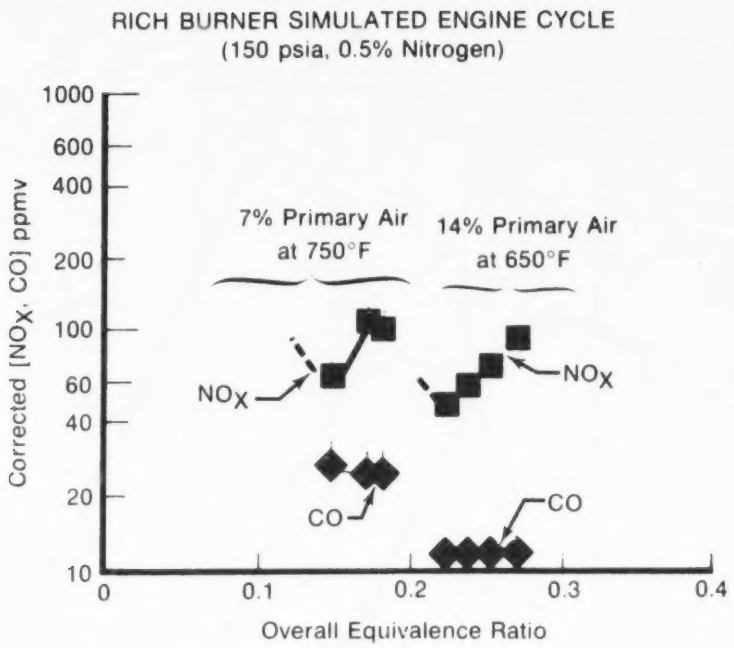


Figure 179. Emissions from Simulated Engine Cycle

In Figure 162, a comparison of the NO_x curves for neat No. 2 distillate fuel oil (having negligible bound nitrogen content) and for No. 2 fuel with 0.5% fuel nitrogen is shown. The effect of the fuel nitrogen is readily apparent in these results. At the minimum point in the NO_x curve, the proportion of total NO_x due to fuel nitrogen is at its minimum value. To the right and to the left of this point (a point that appears to be the optimum primary-zone equivalence ratio for minimizing the conversion of the fuel-bound nitrogen to NO_x), the proportion is significantly higher. Rates of conversion of the fuel nitrogen to NO_x typically were observed to be well above 50% for overall equivalence ratios on either side of the minimum point, while values as low as 10% were observed at the minimum point itself. This minimum point appeared to occur at a primary-zone equivalence ratio near 1.3. Another very important feature of the data shown in Figure 162 is the lack of variation of NO_x with overall equivalence ratio manifested in the curve for neat No. 2 fuel. In the range from 0.10 to 0.22 equivalence ratio, the NO_x concentration measured was essentially constant at 45 ppmv. This result suggests that the Rich Burn/Quick Quench concept may offer NO_x reduction capability over a range of operation wide enough to preclude the need for air staging in the case of fuels containing no appreciable bound nitrogen.

In summary, the following points are emphasized:

1. An optimum fuel-rich primary zone equivalence ratio near 1.3 was demonstrated.

2. This optimum value can be maintained over a wide range of operating conditions through the use of air staging (variable geometry on primary zone airflow).

3. Emission goals of the program can be met with this concept on clean fuels and also fuels with bound nitrogen (specified to 0.5% wt).

4. Virtually no pressure effect on NO_x was found.

5. CO curve remains fixed allowing "independent" control over NO_x and CO.

c. Primary Zone Refinement

Definitive testing of several combustor schemes, Figures 180 through 188, was conducted to evaluate such effects as primary-zone length, primary-zone louver cooling airflow, premixing quality, and flame stabilization on the emission characteristics of the burner. Data were obtained at a number of test conditions selected to simulate a typical engine cycle. As just mentioned, the tests conducted at 150 psia indicated that there was virtually no effect of pressure on the level of the NO_x concentration measured at the bottom of the NO_x "bucket" when compared to the level obtained at 50 psia. Similarly, the influence of increased inlet-air temperature (750 vs 600°F) on measured NO_x concentrations appeared to be a minor one, causing an increase of only about 10 ppmv (60 vs 50 ppmv). A lower inlet-air temperature (320 vs 600°F) was found to cause an increase in both NO_x and CO concentration levels, initially attributed to the result of poorer fuel vaporization (consequently resulting in degraded fuel preparation, causing more combustion at near-stoichiometric conditions and producing more NO_x).

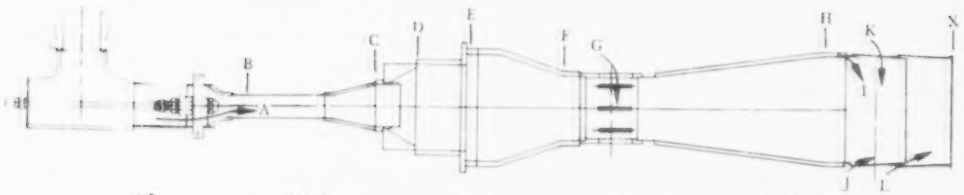
In this test series, utilizing combustor Schemes 29-19A through 29-27A, a tradeoff was documented between primary-zone length and the minimum NO_x concentration achievable at the bottom of the NO_x curve bucket. When the primary-zone length was shortened from 24 to 9 inches, the minimum NO_x concentration increased from about 40 to 80 ppmv (all data at 15% O_2, 600°F and 50 psia, with 0.5% fuel nitrogen). While the 80 ppmv concentration level still satisfied the program goal of 100 ppmv for NO_x, it was evident that primary-zone residence time had a significant influence on NO_x concentration levels. The mode of flame stabilization was also shown to have an influence on NO_x concentration levels. In tests utilizing the long primary zone (24 in.), relatively low NO_x concentrations (40 ppmv) were achieved at the bottom of the NO_x curve bucket without the use of a swirler for positive flame stabilization. However, in tests utilizing the short primary zone (9 in.), the minimum concentration without a swirler was 150 ppmv, while 80 ppmv was achieved when the swirler was present. Thus, to a degree, the disadvantages that may be associated with a lower primary-zone residence time can be offset by improved utilization of volume available.

LB	AKEF	L/D	VOLREF	ACDSUM
30.00	19.63	10.12	692.6	4.66

STATION	AX	ACD
A	2.924	1.020
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	19.998	0.0
F	7.389	0.0
G	7.389	0.761
H	19.079	0.0
I	19.079	0.700
J	19.079	0.119
K	19.079	0.548
L	19.079	0.119
X	113.040	0.753

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	13.10	2.75	0.0
BST4	19.10	2.75	0.0

Figure 180. Bench-Scale Combustor Scheme 29-19A

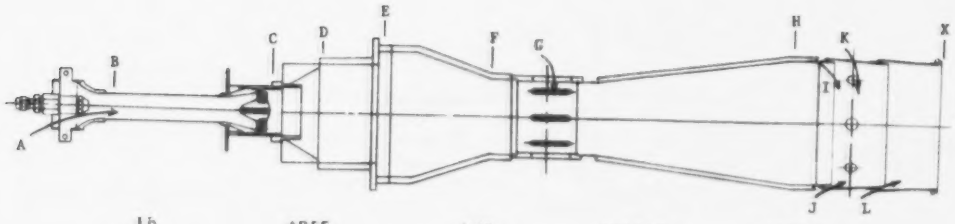


LB	AKEF	L/D	VOLREF	ACDSUM
30.36	19.63	7.27	362.5	4.10

STATION	AX	ACD
A	2.924	1.020
B	0.828	0.0
C	2.924	0.0
D	12.724	0.0
E	19.998	0.0
F	7.389	0.0
G	7.389	0.761
H	19.079	0.0
I	19.079	0.700
J	19.079	0.119
K	19.079	0.548
L	19.079	0.119
X	113.040	0.627

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	10.20	2.25	0.0
BST4	14.00	2.27	0.0

Figure 181. Bench-Scale Combustor Scheme 29-20A

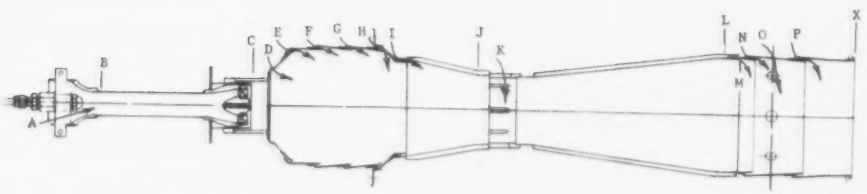


Lb	AREF	L/D	VOLREF	ACDSUM
36.31	19.63	7.26	362.5	3.91

STATION	AX	ACD
A	2.924	0.446
B	0.828	0.0
C	1.766	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.761
H	19.079	0.0
I	19.079	0.700
J	19.079	0.119
K	19.079	0.546
L	19.079	0.119
X	113.040	1.215

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.60	0.56	0.0
BST3	10.20	2.25	0.0
BST4	14.00	2.27	0.0

Figure 182. Bench-Scale Combustor Scheme 29-21A

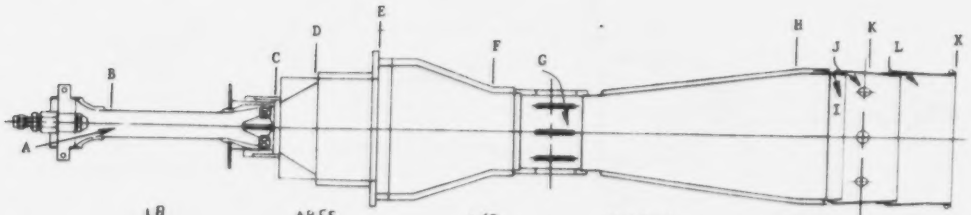


Lb	AREF	L/D	VOLREF	ACDSUM
34.73	19.63	6.95	367.2	5.39

STATION	AX	ACD	WAPCT
A	2.924	0.446	8.276
B	0.828	0.0	0.0
C	1.766	0.0	0.0
D	8.445	0.191	3.359
E	16.560	0.211	3.915
F	21.308	0.153	2.839
G	21.308	0.153	2.839
H	21.719	0.153	2.839
I	14.212	0.129	2.394
J	7.339	0.0	0.0
K	7.389	0.761	14.121
L	19.079	0.0	0.0
M	19.079	0.700	12.989
N	19.079	0.119	2.208
O	19.079	0.548	10.169
P	4.930	0.119	2.208
X	12.000	1.716	31.843

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.0	0.0	0.0
BST2	8.70	1.19	0.0
BST3	11.70	2.63	0.0
BST4	16.70	1.75	0.0

Figure 183. Bench-Scale Combustor Scheme 29-22A

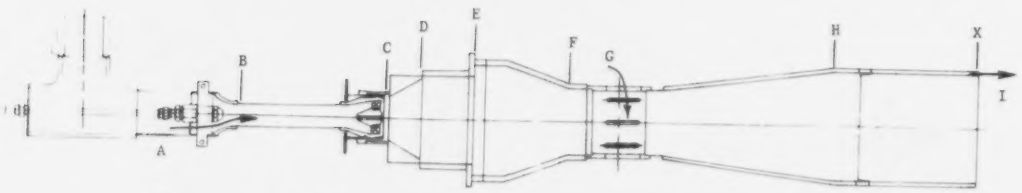


LB	AREF	L/D	VOLREF	ACDSUM
35.56	19.03	7.11	362.5	3.66

STATION	AX	ACD
A	2.924	0.446
B	0.828	0.0
C	1.766	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.761
H	19.079	0.0
I	19.079	0.700
J	19.079	0.119
K	19.079	0.0
L	19.079	0.119
X	113.340	1.519

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	10.20	2.25	0.0
BST4	14.00	2.27	0.0

Figure 184. Bench-Scale Combustor Scheme 29-23A

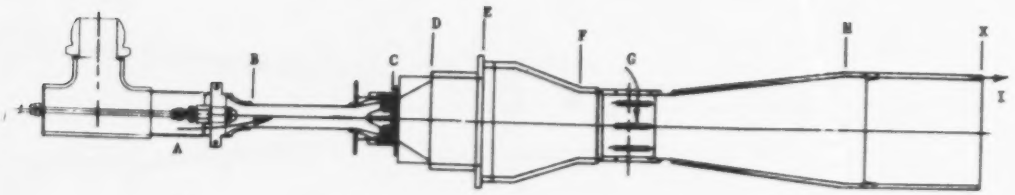


LB	AREF	L/D	VOLREF	ACDSUM
35.71	19.03	7.14	350.2	2.68

STATION	AX	ACD
A	2.924	0.446
B	0.828	0.0
C	1.766	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.588
H	19.079	0.0
I	19.079	0.700
X	113.040	0.949

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	0.0	0.0	0.0
BST4	10.20	2.25	0.0

Figure 185. Bench-Scale Combustor Scheme 29-24A

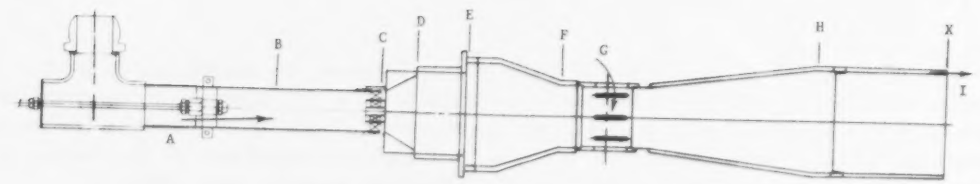


LB	AREF	L/D	VOLREF	ACDSUM
35.71	19.63	7.14	350.2	3.31

STATION	AX	ACD
A	2.924	0.446
B	0.828	0.0
C	7.750	0.380
D	12.724	0.0
E	19.996	0.0
F	7.369	0.0
G	7.389	0.589
H	19.079	0.0
I	19.079	0.730
X	113.040	1.200

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.00	0.56	0.0
BST3	0.0	0.0	0.0
BST4	10.20	2.25	0.0

Figure 186. Bench-Scale Combustor Scheme 29-25A

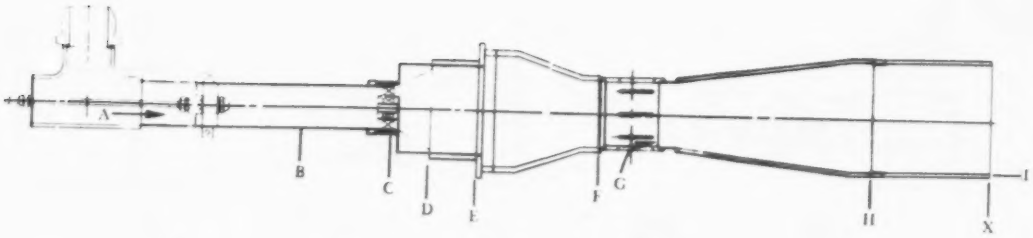


LB	AREF	L/D	VOLREF	ACDSUM
36.71	19.63	7.34	350.2	3.05

STATION	AX	ACD
A	2.924	0.974
B	2.924	0.0
C	2.667	0.0
D	12.724	0.0
E	19.996	0.0
F	7.369	0.0
G	7.389	0.589
H	19.079	0.0
I	19.079	0.700
X	113.040	0.791

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	4.00	1.00	0.0
BST3	11.00	2.25	0.0
BST4	10.00	1.75	0.0

Figure 187. Bench-Scale Combustor Scheme 29-26A



LB	AREF	L/D	VOLREF	ACOSUM
30.21	19.63	7.24	350.2	3.21

STATION	AX	ACC
A	2.924	0.974
B	2.924	1.0
C	2.487	0.0
D	12.124	0.0
E	19.998	0.0
F	7.389	0.0
G	7.389	0.589
H	19.079	0.0
I	19.079	0.700
X	113.040	0.945

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	3.50	1.00	0.0
BST3	10.50	2.25	0.0
BST4	17.50	1.75	0.0

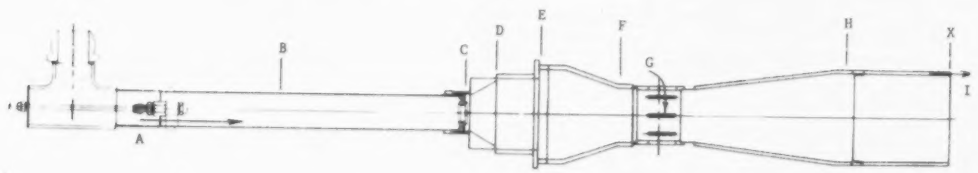
Figure 188. Bench-Scale Combustor Scheme 29-27A

In other tests, the importance of good fuel preparation was evident. In order to help induce a greater volume of airflow into the primary zone, the diameter of the premixing passage was increased from 1 to 2 inches (see Figures 187 and 188). Velocities within the premixing passage were reduced as a result. Although the remainder of the burner was unchanged, the minimum achievable NO_x concentrations increased from about 40 to about 60 ppmv. This increase appears to have been the result of less effective fuel-air mixture preparation (associated with a lower velocity in the premixing tube), which can give rise to diffusion burning and cause increased NO_x production. In two other tests the necessity of eliminating nonpremixed air from the primary zone was demonstrated (all airflow should pass through the premixing tube and become thoroughly mixed with the fuel to preclude the possibility of diffusion burning within the primary zone). In tests for which louver cooling (Scheme 29-22A, Figure 183) was employed in the primary zone, the minimum achievable NO_x concentration increased from 80 to 1 80 ppmv. When primary penetration airholes were opened near the discharge plane of the premixing tube, the minimum achievable NO_x concentration increased from 80 to 140 ppmv. All tests just discussed were conducted with a short primary zone, at 50 psia, 600°F, 15% O_2, and with 0.5% fuel nitrogen.

d. Initial Parametric Investigation

Based on the bench-scale test results obtained up to this point, the Rich Burn/Quick Quench concept was viewed as having the capability to meet the program goals for exhaust emissions. Accordingly, the remaining experimental bench-scale test program was devoted to the generation of the design information necessary to scale the selected concept to a size compatible with a 25-Mw gas turbine can-type combustor. Refinement of the concept was continued with a series of tests conducted using combustors of different primary-zone length, primary-zone volume, and liner pressure drop (see Figures 189 through 204). Although the data obtained were compromised to a degree by incomplete fuel-air preparation, the effects of the parametric variables were not totally obscured, and the results represented the initial input needed to characterize the Rich Burn/Quick Quench concept. In conjunction with these tests, an alternative design for the fuel-air premixing tube, shown in Figure 205, and an alternative method for the addition of the quick-quench airflow (Figures 200 through 203) were also evaluated.

It was initially the objective of this test series to generate parametric design information. In particular, the relationships among primary-zone length and volume, liner pressure drop, combustor loading, and NO_x concentration levels were to have been developed. In the course of conducting the necessary tests however, a general increase in NO_x concentration levels (in particular, an increase in the minimum concentration levels measured at the bottom of the NO_x "bucket") was noted. Because of the definitive nature of the data being generated, it was necessary to isolate the cause of the increased NO_x. Attention was focused on the fuel-air premixing tube, which represented the major difference between the configuration being tested and previous configurations. The fuel-air premixing device had been changed from the initial configuration in an attempt to generate parametric data representative of the lowest achievable NO_x concentration levels. In time it was found that the new premixing tube arrangement (Figure 205) did not provide the high degree of fuel preparation that is believed to be necessary for minimum NO_x concentration levels.

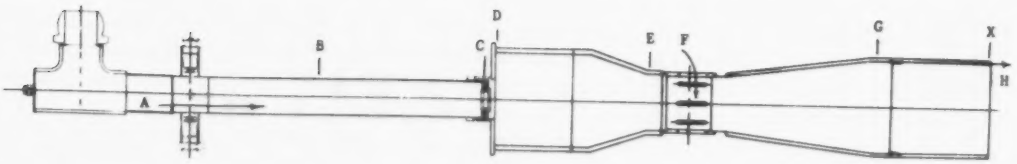


LE	AREF	L/D	VOLREF	ACDSUM
44.84	19.63	8.97	350.2	3.20

STATION	AX	ACD
A	2.924	0.988
B	2.924	0.0
C	2.687	0.0
D	12.724	0.0
E	19.996	0.0
F	7.389	0.0
G	7.389	0.589
H	19.079	0.0
I	19.079	0.700
X	113.040	0.926

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	12.00	1.00	0.0
BST3	20.70	2.25	0.0
BST4	25.70	1.75	0.0

Figure 189. Bench-Scale Combustor Scheme 29-28A

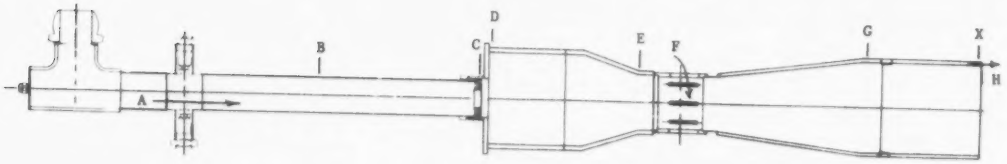


LB	AREF	L/D	VOLREF	ACDSUM
44.66	19.63	8.93	386.2	3.28

STATION	AX	ACD
A	2.924	0.988
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	0.761
G	19.079	0.0
H	19.079	0.700
X	113.040	0.830

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.70	1.00	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 190. Bench-Scale Combustor Scheme 29-29A

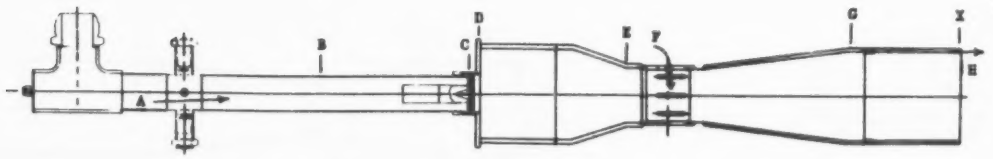


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	3.54

STATION	AX	ACD
A	2.924	1.677
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	0.761
G	19.079	0.0
H	19.079	0.700
X	113.040	0.407

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.70	1.00	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 191. Bench-Scale Combustor Scheme 29-30A

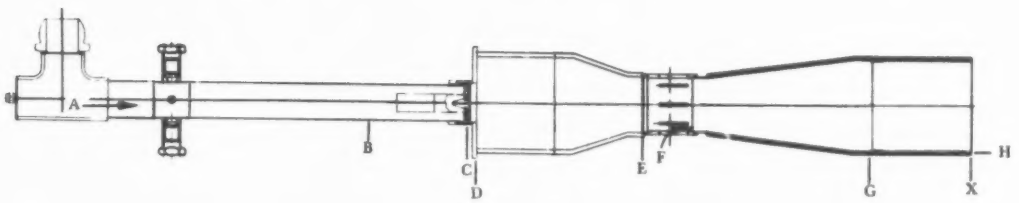


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	3.24

STATION	AX	ACD
A	2.924	1.152
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	0.761
G	19.079	0.0
H	19.079	0.700
X	113.040	0.625

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.70	1.00	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 192. Bench-Scale Combustor Scheme 29-31A

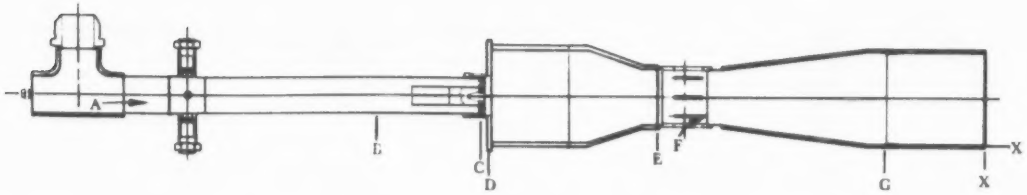


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	3.45

STATION	AX	ACD
A	2.924	1.152
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	0.933
G	19.079	0.0
H	19.079	0.700
X	113.040	0.663

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.70	1.00	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 193. Bench-Scale Combustor Scheme 29-32A

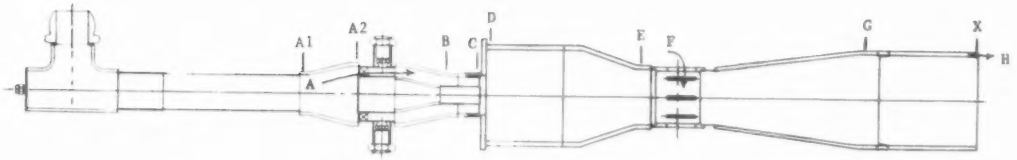


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	3.71

STATION	AX	ACD
A	2.924	1.152
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.166
G	19.079	0.0
H	19.079	0.700
X	113.040	0.746

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.70	1.00	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 194. Bench-Scale Combustor Scheme 29-33A

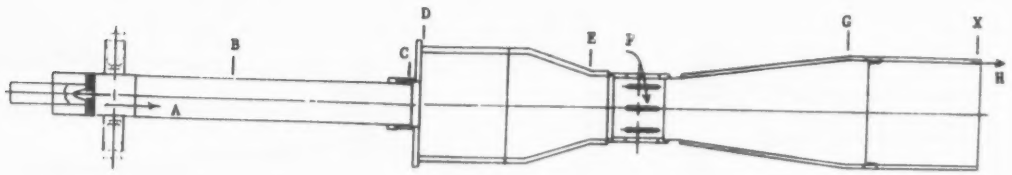


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	3.65

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.669
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.106
G	19.079	0.0
H	19.079	0.700
X	113.040	0.219

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.25	1.50	0.0
BST2	0.0	0.0	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 195. Bench-Scale Combustor Scheme 29-34A

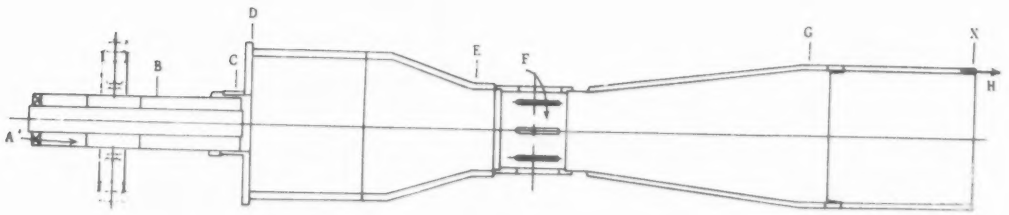


LB	AREF	L/D	VOLREF	ACOSUM
44.68	19.63	6.93	386.2	3.71

STATION	AX	ACD
A	2.924	1.152
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.106
G	19.079	0.0
H	19.079	0.700
X	113.040	0.752

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.25	1.00	0.0
BST2	0.0	0.0	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 196. Bench-Scale Combustor Scheme 29-35A

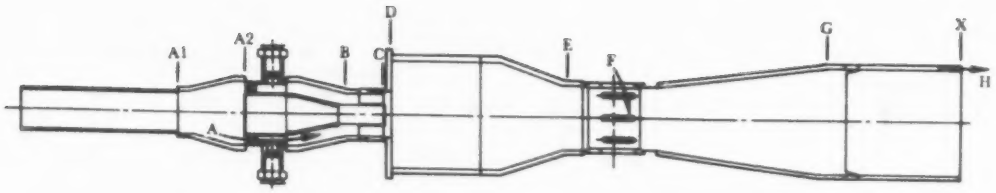


LB	AREF	L/D	VOLREF	ACOSUM
55.24	19.63	7.05	386.2	3.62

STATION	AX	ACD
A	2.924	0.942
B	2.924	0.0
C	3.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.149
G	19.079	0.0
H	19.079	0.700
X	113.040	0.862

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	5.00	1.00	0.0
BST2	0.0	0.0	0.0
BST3	9.10	2.78	0.0
BST4	17.30	1.75	0.0

Figure 197. Bench-Scale Combustor Scheme 29-36A

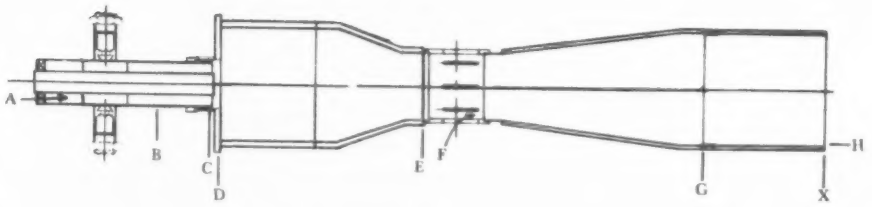


LB	AREF	L/D	VOLREF	ACDSUM
44.68	19.63	8.93	386.2	4.44

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.636
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	0.413

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	11.25	1.50	0.0
BST2	0.0	0.0	0.0
BST3	18.50	2.78	0.0
BST4	26.70	1.75	0.0

Figure 198. Bench-Scale Combustor Scheme 29-37A

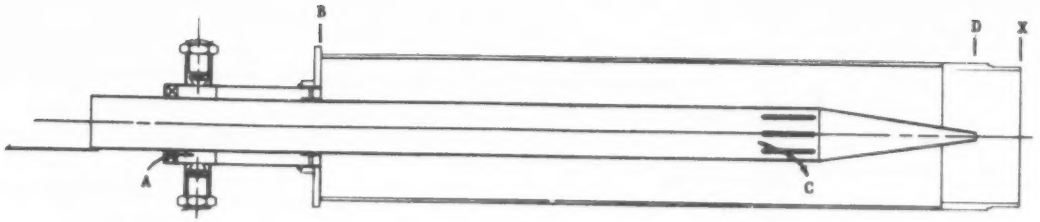


LB	AREF	L/D	VOLREF	ACDSUM
35.24	19.63	7.05	386.2	4.18

STATION	AX	ACD
A	2.924	0.942
B	2.924	0.0
C	5.652	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	0.842

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	5.00	1.00	0.0
BST2	0.0	0.0	0.0
BST3	9.10	2.78	0.0
BST4	17.30	1.75	0.0

Figure 199. Bench-Scale Combustor Scheme 29-38A

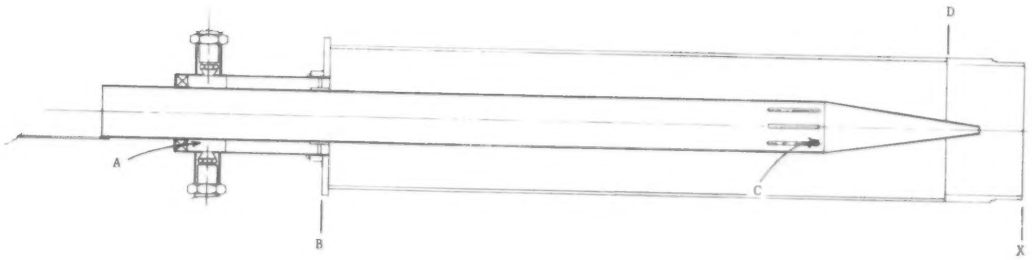


LB	AREF	L/D	VOLREF	ACDSUM
32.90	22.44	6.15	596.3	3.78

STATION	AX	ACD
A	6.739	1.638
B	22.427	0.0
C	22.427	1.739
D	19.996	0.0
X	113.040	0.400

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.50	0.0
BST2	0.0	0.0	0.0
BST3	11.80	2.78	0.0
BST4	0.0	0.0	0.0

Figure 200. Bench-Scale Combustor Scheme 29-39A

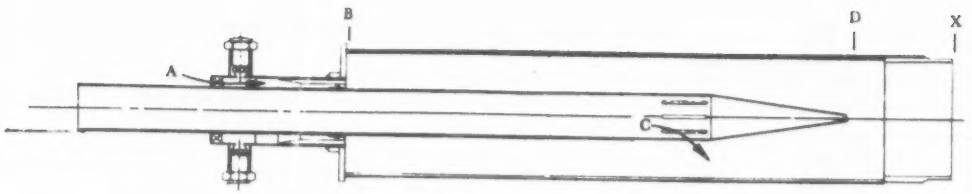


LB	AREF	L/D	VOLREF	ACDSUM
32.90	22.44	6.15	596.3	3.66

STATION	AX	ACD
A	6.739	0.655
B	22.427	0.0
C	22.427	1.738
D	19.996	0.0
X	113.040	1.239

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.50	0.0
BST2	0.0	0.0	0.0
BST3	11.80	2.78	0.0
BST4	0.0	0.0	0.0

Figure 201. Bench-Scale Combustor Scheme 29-40A

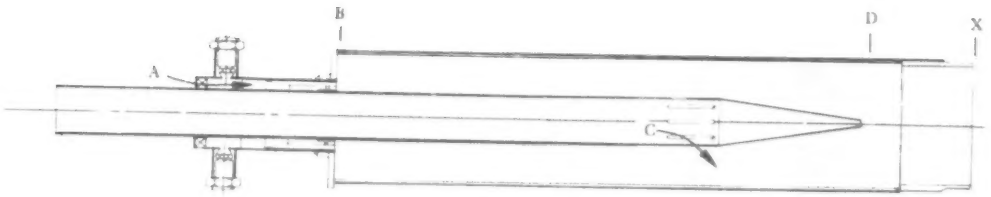


LB	AREF	L/D	VOLREF	ACDSUM
32.90	22.44	6.15	596.3	3.17

STATION	AX	ACD
A	6.739	0.944
B	22.427	0.0
C	22.427	1.738
D	19.996	0.0
X	113.040	0.487

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.50	0.0
BST2	0.0	0.0	0.0
BST3	11.80	2.78	0.0

Figure 202. Bench-Scale Combustor Scheme 29-41A

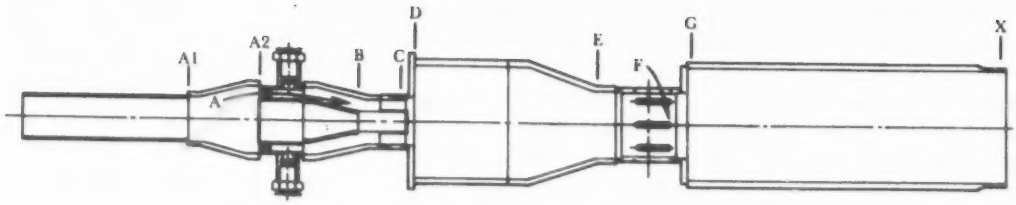


LB	AREF	L/D	VOLREF	ACDSUM
32.90	22.44	6.15	596.3	3.17

STATION	AX	ACD
A	6.739	0.944
B	22.427	0.0
C	22.427	1.738
D	19.996	0.0
X	113.040	0.487

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	1.50	0.0
BST2	0.0	0.0	0.0
BST3	11.80	2.78	0.0

Figure 203. Bench-Scale Combustor Scheme 29-42A



LE	AREF	L/D	VOLREF	ACDSUM
44.65	22.44	8.36	460.7	3.37

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.500
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.589	0.0
F	6.484	1.694
G	19.996	0.0
X	113.640	0.174

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	12.40	1.50	0.0
BST2	0.0	0.0	0.0
BST3	18.40	2.78	0.0
BST4	26.90	1.75	0.0

Figure 204. Bench-Scale Combustor Scheme 29-43A

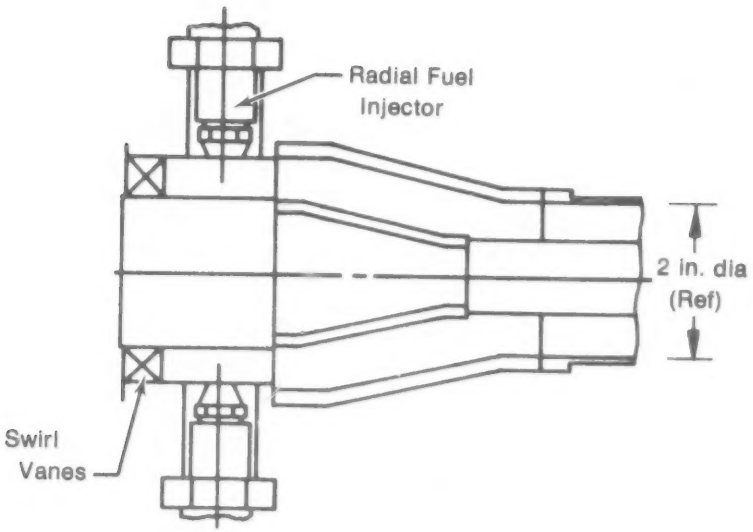


Figure 205. Alternative Premixing Tube

The alternative premixing tube design differed from the premixing tube previously used in three respects: (1) the swirler was located at the inlet to the premixing passage rather than at the discharge plane; (2) four side-mounted fuel injectors were provided, compared to one centrally located injector used previously; and (3) the premixing passage was annular rather than cylindrical. The primary advantage to the alternative design is that the swirler was located upstream of the fuel injection plane, eliminating the possibility of unwanted flameholding either within or upstream of the swirler vanes. A second potential advantage is that the greater number of point sources of fuel can lead to improved fuel distribution.

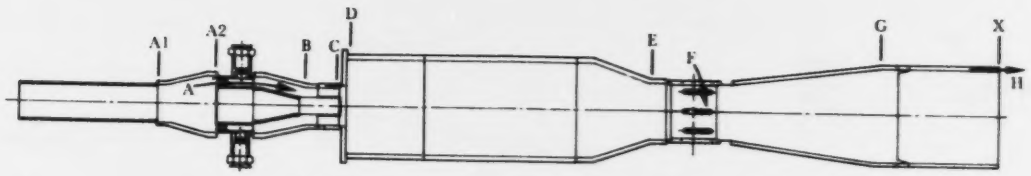
In the tests conducted mixed results were obtained. Very good fuel preparation was achieved under conditions of low fuel loading. For example, in one series of tests in which the fuel flowrate was reduced to achieve an overall lean condition within the primary zone, a NO_x concentration of 3 ppmv (uncorrected) was recorded. This extremely low concentration could not have been achieved without essentially perfect fuel prevaporization and premixing. On the other hand, incomplete fuel preparation was indicated under conditions of high fuel loading. At the burner design point condition, for example, the fuel mass flowrate is about 30% greater than the air mass flowrate within the premixing passage. At this condition and at other points within this general range of operation, the NO_x concentration levels measured with the alternative premixing tube were consistently higher (by about 20 ppmv) than those that had been obtained previously with the original premixing tube. After evaluating the results of a number of comparison tests in which the premixing tube was the only feature varied, it was concluded that a slight deterioration in the degree of fuel prevaporization or fuel-air premixing had occurred in the case of the alternative design. This deterioriation caused a slight shift toward diffusion burning in the primary zone, resulting in somewhat higher NO_x concentration levels. The effort expended in resolving this matter yielded two main benefits. First, the importance of good fuel preparation in the maintenance of low NO_x concentration levels was documented. Second, experience was gained with an alternative premixing tube configuration that has several attractive, conservative design features. Even though the initial test results were not as good as those obtained using the original configuration, these test results could serve as a starting point for future successful refinements of the premixing device.

e. Alternative Dilution Scheme

Tests of an alternative method for the addition of quick-quench airflow were next explored (see Figures 200 through 203). Initial testing of the schemes depicted indicated that excessive airflow was entering the primary zone through the premixing passage. This made the establishment of fuel-rich conditions within the primary combustion volume impossible. Modifications were made to restrict the airflow through the premix tube. Retesting indicated that NO_x levels were not as good as those achieved earlier. The dilution tube was subsequently moved forward (less primary-zone residence time) with the result that NO_x increased slightly over the original position. It was thought that introducing airflow from a centertube structure might offer an effective alternative to the baseline (reduced diameter) method, and might also facilitate the introduction of provisions for variable primary zone residence times (effected by translation of the centertube during operation of the combustor). However, these initial centertube configurations failed to produce the same low emissions as the baseline version. It was thought that the reason for this was that an ineffective quenching process had been established, perhaps due to the outboard direction of jet spreading and perhaps due to low mainstream velocities, compromising the transition between the primary and secondary zones.

f. Primary Zone Residence Time

The bench-scale test program was concluded with tests of the combustor configurations depicted in Figures 206 through 240. Reference is made in the following paragraphs and in subsequent sections to these figures, not necessarily in chronological order.

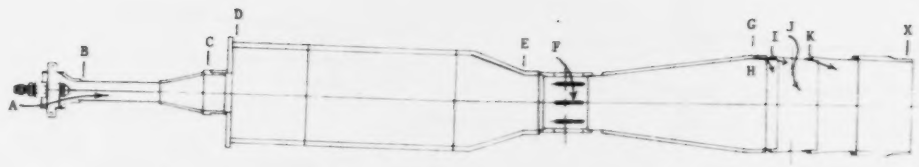


LB	AREF	L/D	VOLREF	ACDSUM
52.66	19.64	10.55	546.3	4.26

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.593
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	0.384

MEMBER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	12.40	1.50	0.0
BST2	0.0	0.0	0.0
BST3	18.40	2.78	0.0
BST4	34.60	1.75	0.0

Figure 206. Bench-Scale Combustor Scheme 29-44A

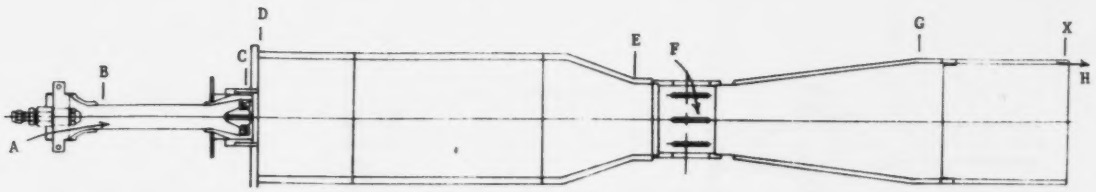


LB	AREF	L/D	VOLREF	ACDSUM
48.23	19.09	9.78	606.3	4.31

STATION	AX	ACD
A	2.924	1.626
B	0.626	0.0
C	2.924	0.0
D	19.996	0.0
E	7.389	0.0
F	7.389	0.701
G	19.079	0.0
H	19.079	0.700
I	19.079	0.119
J	19.079	0.569
K	19.079	0.119
X	113.040	1.036

MEMBER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.50	0.56	0.0
BST2	0.0	0.0	0.0
BST3	11.10	2.78	0.0
BST4	28.80	1.75	0.0

Figure 207. Bench-Scale Combustor Scheme 29-45A

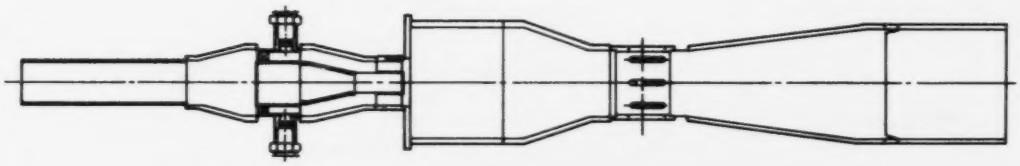


LB	AREF	L/D	VOLREF	ACDSUM
46.06	19.09	9.34	541.2	4.00

STATION	AX	ACD
A	2.924	0.446
B	0.828	0.0
C	1.766	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	1.158

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	3.00	0.56	0.0
BST2	0.0	0.0	0.0
BST3	9.30	2.78	0.0
BST4	24.80	1.75	0.0

Figure 208. Bench-Scale Combustor Scheme 29-46A

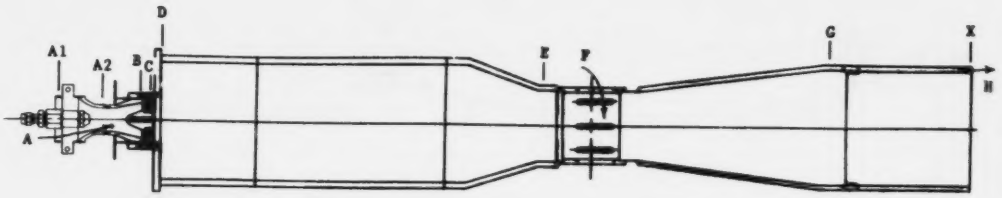


LB	AREF	L/D	VOLREF	ACDSUM
52.43	19.64	10.48	541.4	4.46

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.139	1.500
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.389	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	0.562

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	12.40	1.56	0.0
BST2	0.0	0.0	0.0
BST3	18.40	2.78	0.0
BST4	34.75	1.75	0.0

Figure 209. Bench-Scale Combustor Scheme 29-47A

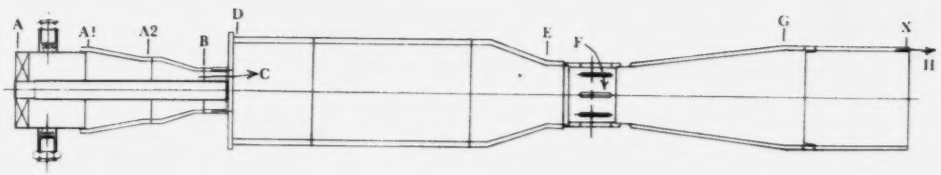


LB	AREF	L/D	VOLREF	ACDSUM
39.48	19.09	8.01	541.2	4.14

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.365	0.0
F	6.484	1.894
G	19.079	0.0
H	19.079	0.700
X	113.040	1.303

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.50	0.56	0.0
BST2	0.0	0.0	0.0
BST3	5.80	2.78	0.0
BST4	21.10	1.75	0.0

Figure 210. Bench-Scale Combustor Scheme 29-48A

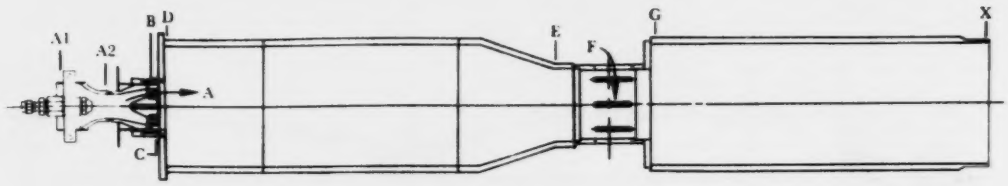


LB	AREF	L/D	VOLREF	ACDSUM
46.12	19.09	9.35	541.2	5.46

STATION	AX	ACD
A	11.345	0.0
A1	11.781	0.0
A2	6.283	0.0
B	2.356	0.0
C	2.356	1.461
D	5.047	0.0
E	3.063	0.0
F	2.874	1.694
G	4.930	0.0
H	4.930	0.700
X	12.000	1.607

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	7.19	3.19	0.0
BST2	0.0	0.0	0.0
BST3	12.35	2.78	0.0
BST4	27.65	1.75	0.0

Figure 211. Bench-Scale Combustor Scheme 29-49A

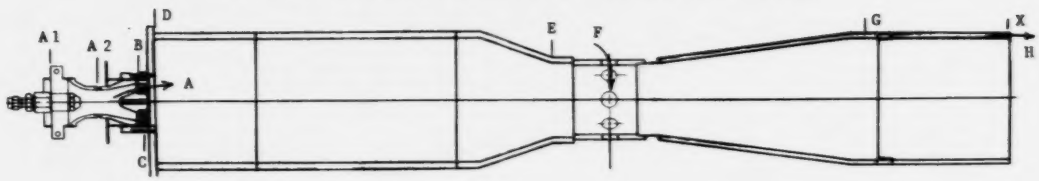


LB	AREF	L/D	VOLREF	ACDSUM
39.48	19.09	8.01	615.8	3.15

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.44e
B	1.766	0.0
C	1.766	0.0
D	19.99e	0.0
E	7.365	0.0
F	6.484	1.e94
G	19.079	0.0
X	113.040	1.012

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.80	2.78	0.0
BST4	21.20	1.75	0.0

Figure 212. Bench-Scale Combustor Scheme 29-50A

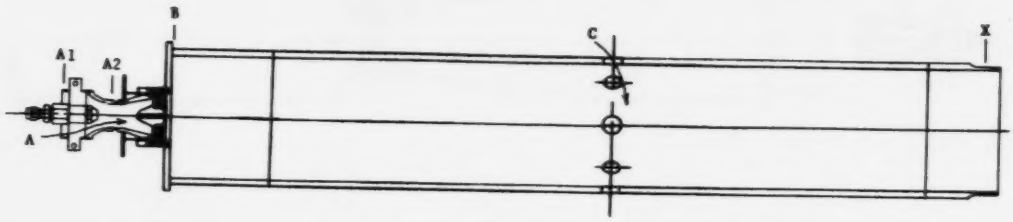


LB	AREF	L/D	VOLREF	ACDSUM
39.48	19.09	8.01	541.2	3.95

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.44e
B	1.766	0.0
C	1.766	0.0
D	19.990	0.0
E	7.365	0.0
F	6.484	1.e94
G	19.079	0.0
H	19.079	0.700
X	113.040	1.112

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.80	2.78	0.0
BST4	21.10	1.75	0.0

Figure 213. Bench-Scale Combustor Scheme 29-51A

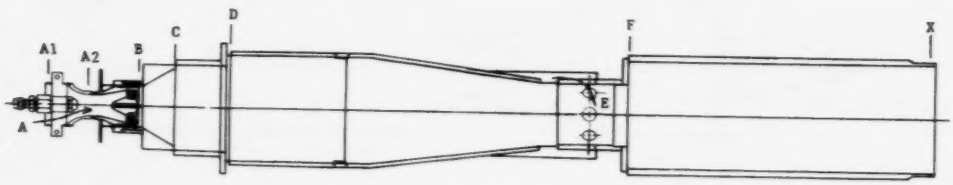


LB	AREF	L/D	VOLREF	ACOSUM
39.48	19.09	8.01	698.2	2.96

STATION	AX	ACO
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	19.996	0.0
C	19.996	1.694
X	113.040	0.822

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.80	2.78	0.0
BST4	21.10	2.78	0.0

Figure 214. Bench-Scale Combustor Scheme 29-52A

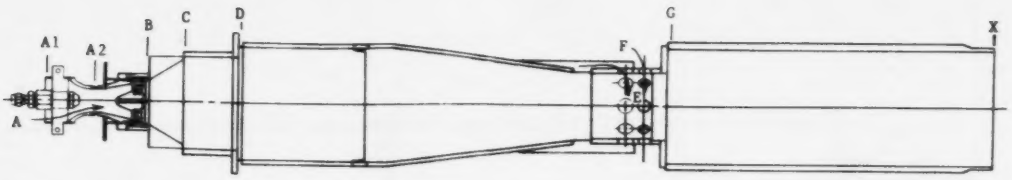


LB	AREF	L/D	VOLREF	ACOSUM
46.26	19.09	9.38	582.1	2.21

STATION	AX	ACO
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.652	0.0
C	12.724	0.0
D	19.079	0.0
E	6.484	0.512
F	19.996	0.0
X	113.040	1.151

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	7.80	4.13	0.0
BST4	23.30	4.00	0.0

Figure 215. Bench-Scale Combustor Scheme 29-53A

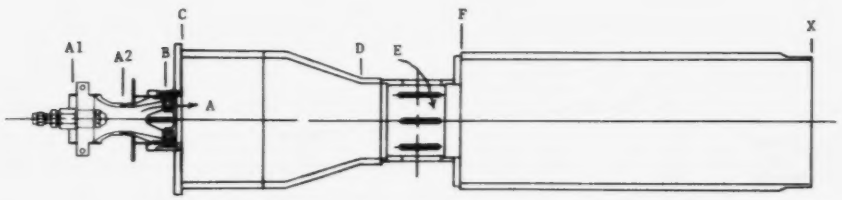


LB	AREF	L/D	VOLREF	ACDSUM
46.26	19.09	9.38	582.1	3.37

STATION	AX	ACC
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.052	0.0
C	12.724	0.0
D	19.079	0.0
E	6.484	0.512
F	6.484	1.252
G	19.498	0.0
X	113.040	1.180

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	7.90	4.13	0.0
BST4	23.30	4.00	0.0

Figure 216. Bench-Scale Combustor Scheme 29-54A

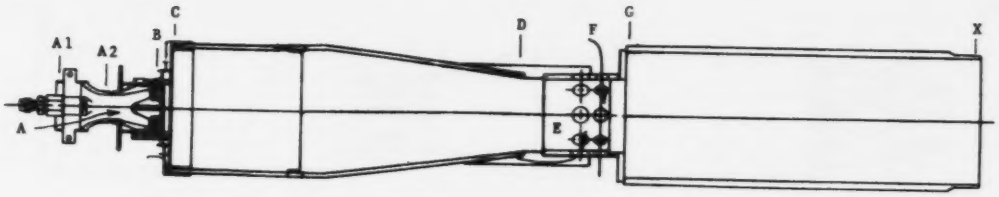


LB	AREF	L/D	VOLREF	ACDSUM
30.73	19.09	6.23	448.0	2.94

STATION	AX	ACC
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	1.766	0.0
C	19.996	0.0
D	7.365	0.0
E	6.484	1.694
F	19.996	0.0
X	113.040	0.803

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.80	2.78	0.0
BST4	12.40	1.75	0.0

Figure 217. Bench-Scale Combustor Scheme 29-55A

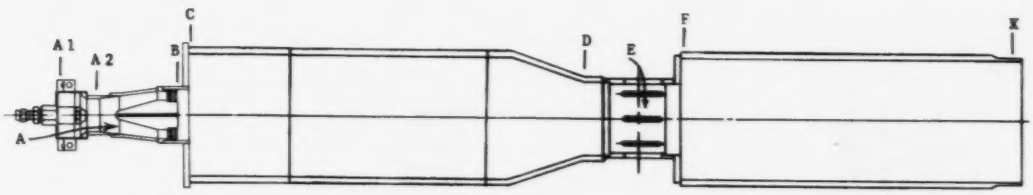


LB	AREF	L/D	VOLREF	ACDSUM
37.51	19.09	7.61	529.9	3.06

STATION	AX	ACD
A1	2.924	0.0
A2	0.628	0.0
A	1.766	0.446
B	3.696	0.0
C	19.079	0.0
D	6.484	0.0
E	6.484	0.512
F	6.484	1.232
G	19.996	0.0
X	113.040	0.867

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.50	0.57	0.0
BST2	0.0	0.0	0.0
BST3	5.50	2.70	0.0
BST4	19.00	2.00	0.0

Figure 218. Bench-Scale Combustor Scheme 29-56A

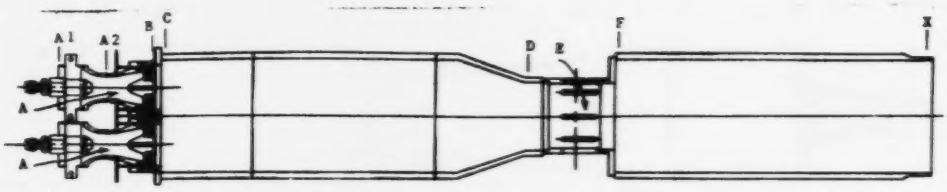


LB	AREF	L/D	VOLREF	ACDSUM
40.53	19.09	8.22	671.6	3.20

STATION	AX	ACD
A1	2.924	0.0
A2	1.539	0.0
A	1.766	0.756
B	1.766	0.0
C	19.996	0.0
D	7.365	0.0
E	6.484	1.694
F	19.079	0.0
X	113.040	0.750

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	1.80	0.62	0.0
BST2	0.0	0.0	0.0
BST3	6.38	2.78	0.0
BST4	22.58	1.75	0.0

Figure 219. Bench-Scale Combustor Scheme 29-57A

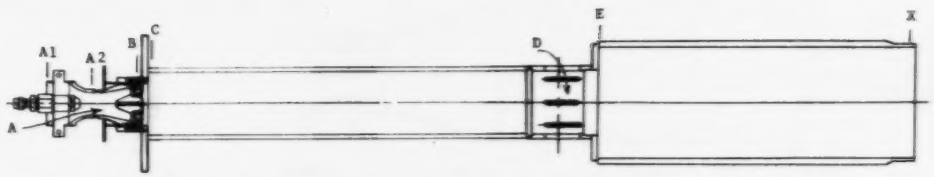


LB	AREF	L/D	VOLREF	ACDSUM
39.60	19.09	8.03	671.9	3.23

STATION	AX	ACD
A1	5.851	0.0
A2	1.657	0.0
A	2.756	0.894
B	7.308	0.0
C	19.996	0.0
D	7.385	0.0
E	6.484	1.694
F	19.079	0.0
X	113.040	0.649

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.50	2.78	0.0
BST4	21.70	1.75	0.0

Figure 220. Bench-Scale Combustor Scheme 29-58A

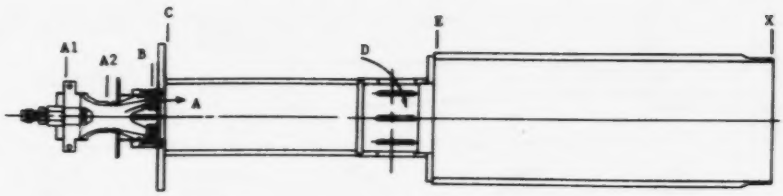


LB	AREF	L/D	VOLREF	ACDSUM
39.73	0.49	13.82	413.7	2.86

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	6.484	0.0
D	6.484	1.694
E	19.079	0.0
X	113.040	0.725

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	5.80	1.63	0.0
BST4	21.30	1.63	0.0

Figure 221. Bench-Scale Combustor Scheme 29-59A

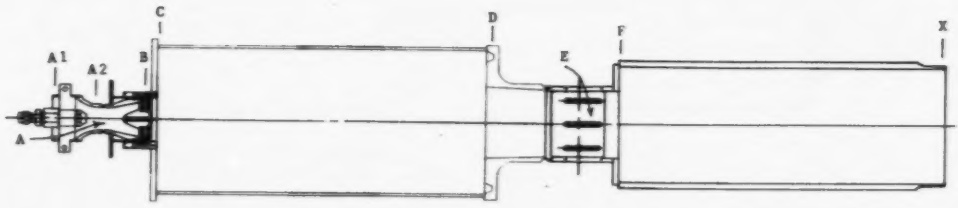


LB	AREF	L/D	VOLREF	ACDSUM
30.73	6.49	10.69	355.3	2.68

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	6.484	0.0
D	0.484	1.694
E	19.079	0.0
X	113.040	0.508

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	0.0	0.0	0.0
BST4	8.80	1.63	0.0

Figure 222. Bench-Scale Combustor Scheme 29-60A

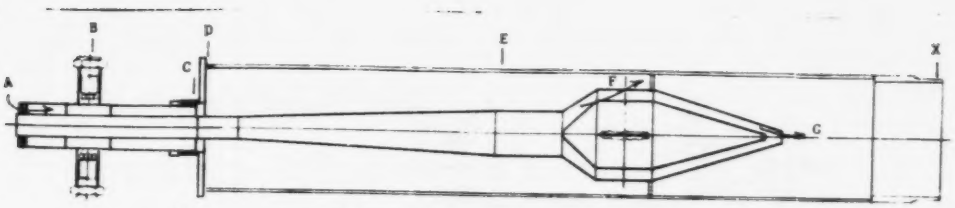


LE	AREF	L/D	VOLREF	ACDSUM
39.73	32.24	6.20	799.2	2.75

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	32.224	0.0
D	7.065	0.0
E	6.484	1.694
F	19.079	0.0
X	113.040	0.608

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	0.0	0.0	0.0
BST3	6.80	3.31	0.0
BST4	21.60	3.31	0.0

Figure 223. Bench-Scale Combustor Scheme 29-61A

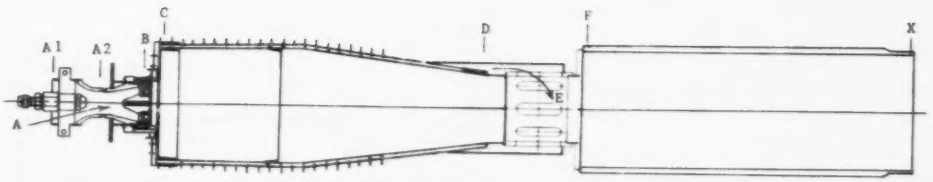


LB	AREF	L/D	VOLREF	ACDSUM
41.04	19.09	8.33	560.4	2.26

STATION	AX	ACD
A	1.994	0.942
B	1.994	0.0
C	2.767	0.0
D	19.079	0.0
E	16.880	0.0
F	7.439	0.573
G	23.006	0.041
X	113.040	0.700

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	0.00	1.03	0.0
EST2	0.0	0.0	0.0
EST3	10.00	4.78	0.0
EST4	28.00	4.78	0.0

Figure 224. Bench-Scale Combustor Scheme 29-62A

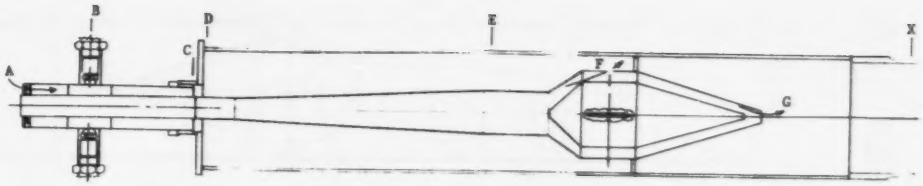


LB	AREF	L/D	VOLREF	ACDSUM
37.51	19.09	7.61	522.7	2.10

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	19.079	0.0
D	0.739	0.0
E	0.484	0.953
F	19.079	0.0
X	113.040	0.700

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	6.06	5.00	0.0
EST2	8.59	5.00	0.0
EST3	11.08	4.86	0.0
EST4	13.58	4.27	0.0

Figure 225. Bench-Scale Combustor Scheme 29-63A

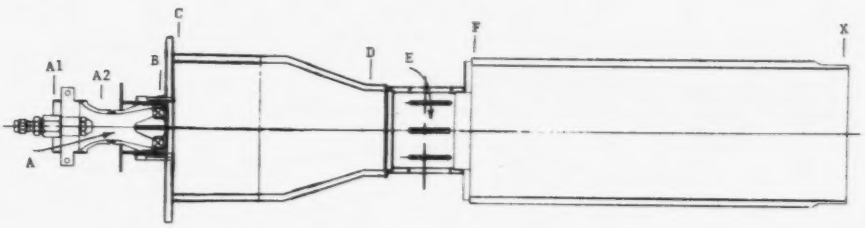


LB	AREF	L/D	VOLREF	ACDSUM
41.09	19.09	6.33	560.4	2.37

STATION	AX	ACD
A	1.994	0.942
B	1.994	0.0
C	2.767	0.0
D	19.074	0.0
E	16.863	0.0
F	7.439	0.710
G	20.006	0.017
X	113.040	0.700

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	1.03	0.0
BST2	10.00	2.78	0.0
BST3	28.00	2.78	0.0

Figure 226. Bench-Scale Combustor Scheme 29-64A

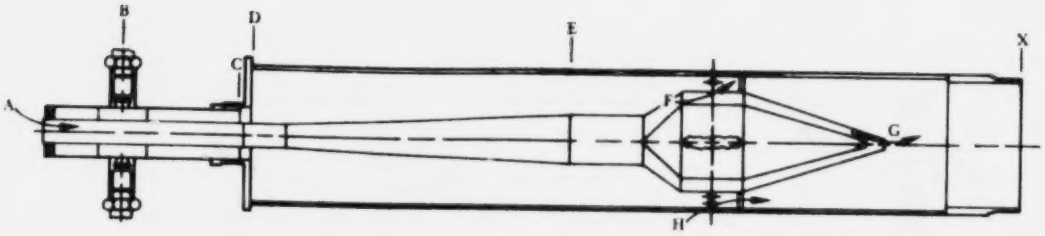


LB	AREF	L/D	VOLREF	ACDSUM
30.73	19.09	6.23	448.0	2.95

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	19.996	0.0
D	7.365	0.0
E	6.484	1.694
F	19.079	0.0
X	113.040	0.810

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	5.80	2.78	0.0
BST3	12.40	1.75	0.0

Figure 227. Bench-Scale Combustor Scheme 29-65A

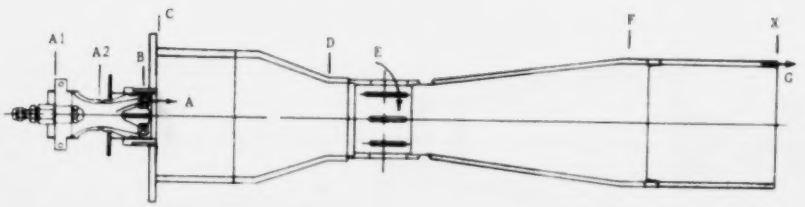


LB	AREF	L/D	VOLREF	ACDSUM
39.39	19.09	8.03	530.4	3.44

STATION	AX	ACD	WAPCT
A	1.994	0.94.	47.408
B	1.994	0.0	0.0
C	2.767	0.0	0.0
D	19.074	0.0	0.0
E	18.880	0.0	0.0
F	7.439	0.716	20.058
G	20.006	0.017	0.495
H	7.459	0.943	27.437
X	113.040	0.629	44.003

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	6.00	1.03	0.0
EST2	10.00	2.78	0.0
EST3	28.00	2.78	0.0

Figure 228. Bench-Scale Combustor Scheme 29-66A



LB	AREF	L/D	VOLREF	ACDSUM
30.73	19.09	6.23	361.4	3.62

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.496
B	3.696	0.0
C	19.996	0.0
D	7.365	0.0
E	6.484	1.694
F	19.079	0.0
G	19.079	0.700
X	113.040	0.750

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	0.0	0.0	0.0
EST2	5.80	2.78	0.0
EST3	12.40	1.75	0.0

Figure 229. Bench-Scale Combustor Scheme 29-67A

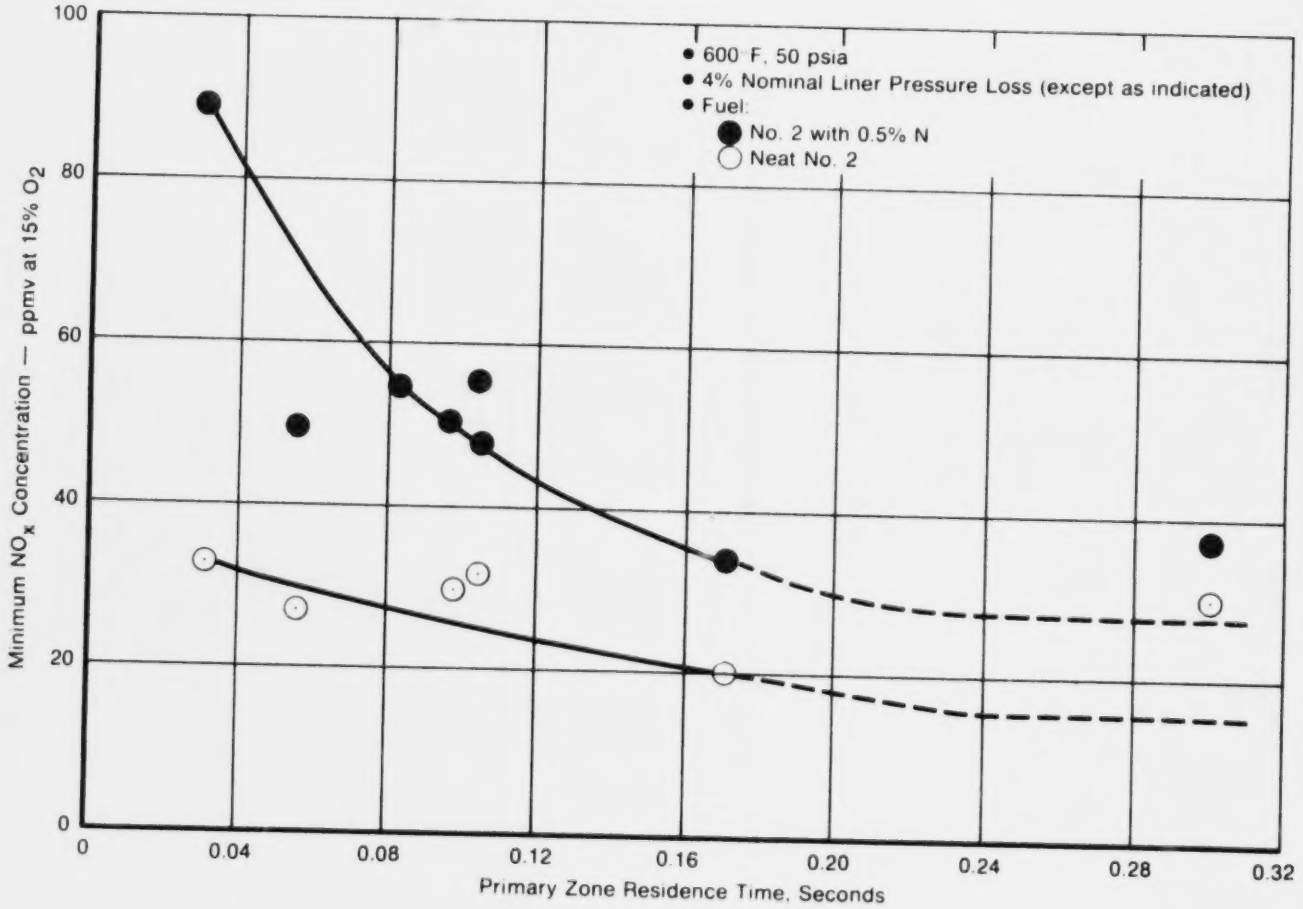
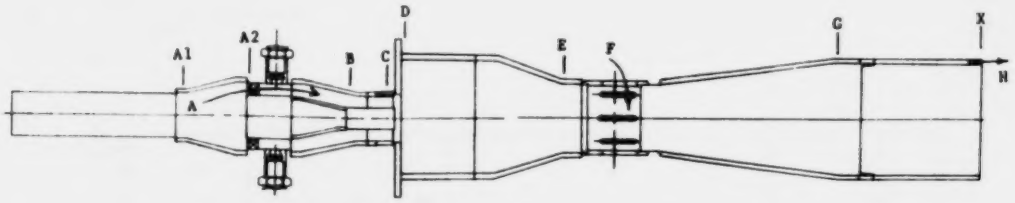


Figure 230. Minimum NO_x as a Function of Primary Zone Residence Time

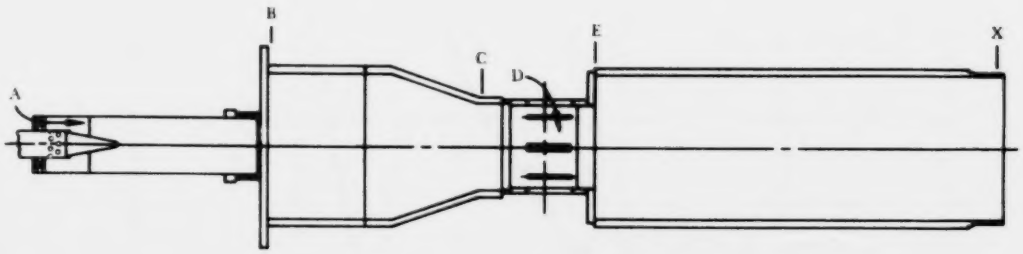


LB	AREF	L/D	VOLREF	ACDSUM
43.68	19.09	8.66	361.4	4.21

STATION	AX	ACD
A1	2.924	0.0
A2	6.739	0.0
A	6.739	1.500
B	3.140	0.0
C	3.696	0.0
D	19.996	0.0
E	7.365	0.0
F	6.484	1.694
G	19.079	0.0
H	19.079	0.700
X	113.040	0.315

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	10.60	1.12	0.0
BST2	15.70	2.78	0.0
BST3	25.50	1.75	0.0

Figure 231. Bench-Scale Combustor Scheme 29-68A

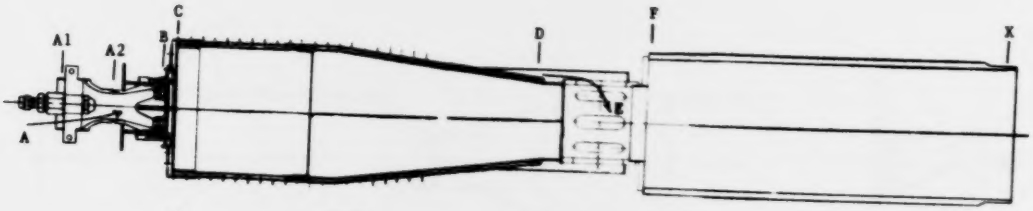


LB	AREF	L/D	VOLREF	ACDSUM
34.24	19.09	6.94	448.0	2.96

STATION	AX	ACD
A	2.924	0.663
B	19.996	0.0
C	7.365	0.0
D	6.484	1.694
E	19.079	0.0
X	113.040	0.606

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.00	1.00	0.0
BST2	9.10	2.78	0.0
BST3	15.60	1.75	0.0

Figure 232. Bench-Scale Combustor Scheme 29-69A

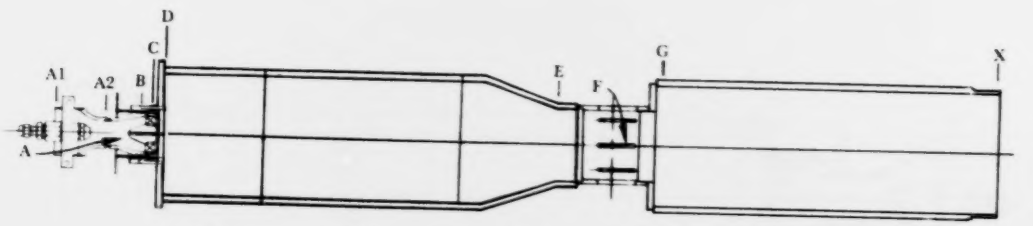


LB	AREF	L/D	VOLREF	ACDSUM
37.51	19.09	7.61	522.7	2.22

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	3.696	0.0
C	19.079	0.0
D	6.739	0.0
E	6.484	1.170
F	19.079	0.0
X	113.040	0.600

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	6.08	5.00	0.0
EST2	8.58	5.00	0.0
EST3	11.08	4.86	0.0
EST4	13.58	4.27	0.0

Figure 233. Bench-Scale Combustor Scheme 29-70A

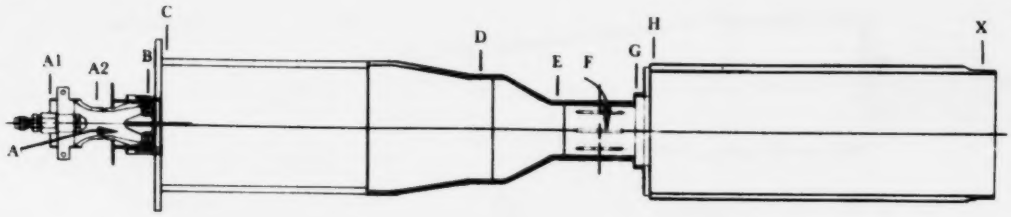


LB	AREF	L/D	VOLREF	ACDSUM
39.48	19.09	8.01	615.8	3.58

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.365	1.0
F	6.484	1.694
G	19.079	0.0
X	113.040	1.458

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
EST1	6.00	2.79	0.0
EST2	16.00	2.78	0.0

Figure 234. Bench-Scale Combustor Scheme 29-71A

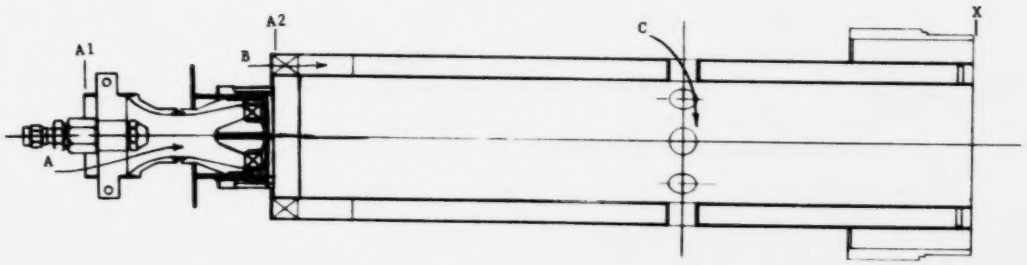


LB	AREF	L/D	VOLREF	ACDSUM
39.65	20.01	7.69	593.8	3.61

STATION	AX	ACD
A1	2.924	0.0
A2	0.628	0.0
A	1.766	0.446
B	3.696	0.0
C	19.996	0.0
D	14.246	0.0
E	3.652	0.0
F	3.652	1.094
G	6.739	0.0
H	19.996	0.0
X	113.040	1.472

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.00	1.50	0.0
BST2	10.50	2.78	0.0
BST3	12.50	2.78	0.0

Figure 235. Bench-Scale Combustor Scheme 29-72A

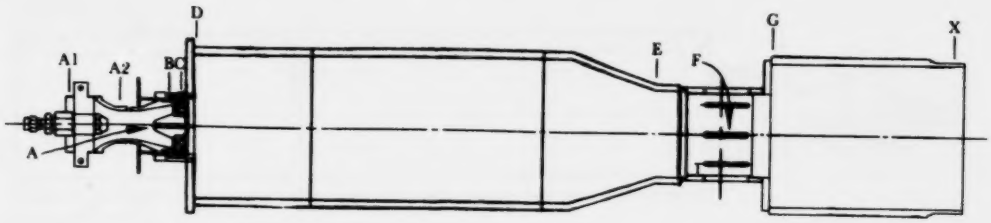


LB	AREF	L/D	VOLREF	ACDSUM
21.58	6.74	7.36	114.6	6.11

STATION	AX	ACD
A1	2.924	0.0
A2	3.696	0.0
A	1.766	0.446
B	12.124	2.272
C	6.739	1.656
X	113.040	1.741

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	6.58	1.50	0.0
BST2	8.58	1.50	90.0
BST3	10.58	1.50	180.0
BST4	12.58	1.50	270.0

Figure 236. Bench-Scale Combustor Scheme 29-73A

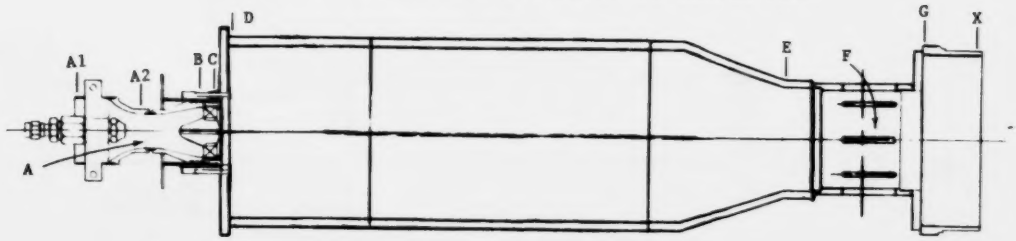


Lb	AREF	L/D	VOLREF	ACDSUM
32.16	19.09	6.52	476.0	3.17

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.365	0.0
F	6.484	1.694
G	19.079	0.0
X	113.040	1.033

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.00	0.75	0.0
BST2	6.00	2.78	0.0
BST3	16.00	2.78	0.0

Figure 237. Bench-Scale Combustor Scheme 29-74A



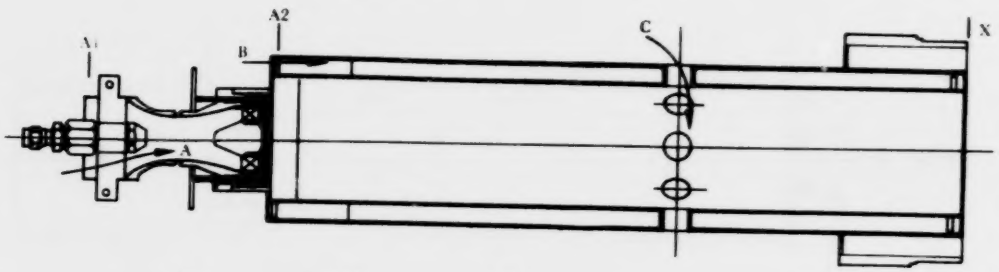
LB	AREF	L/D	VOLREF	ACDSUM
26.84	19.09	5.44	369.5	3.03

STATION	AX	ACD
A1	2.924	0.0
A2	0.828	0.0
A	1.766	0.446
B	1.766	0.0
C	1.766	0.0
D	19.996	0.0
E	7.365	0.0
F	6.484	1.694
G	19.079	0.0
X	113.040	0.886

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.00	0.75	0.0
BST2	6.00	2.78	0.0
BST3	16.00	2.78	0.0

Figure 238. Bench-Scale Combustor Scheme 29-75A

Reproduced from
best available copy.

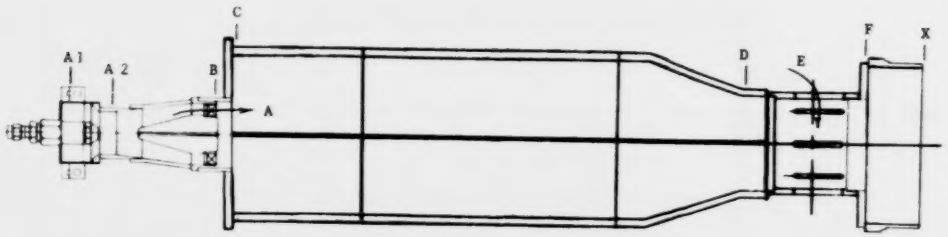


LB	AREF	L/D	VOLREF	ACDSUM
21.58	0.74	7.36	114.6	0.01

STATION	AX	ACD
A1	2.924	0.0
A2	3.696	0.0
A	1.700	0.491
B	12.124	0.292
C	0.739	1.042
X	113.340	0.033

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	0.0	0.0	0.0
BST2	8.58	1.50	90.0
BST3	10.58	1.50	180.0
BST4	12.58	1.50	270.0

Figure 239. Bench-Scale Combustor Scheme 29-76A



LB	AREF	L/D	VOLREF	ACDSUM
27.88	19.09	5.65	369.5	3.26

STATION	AX	ACD
A1	2.924	0.0
A2	1.539	0.0
A	1.766	0.756
B	1.766	0.0
C	19.996	0.0
D	7.365	0.0
E	0.484	1.694
F	19.079	0.0
X	113.040	0.813

HEADER	AXIAL LOC	RAD LOC	CIRCUM LOC
BST1	4.00	0.75	0.0
BST2	6.00	2.78	0.0
BST3	16.00	2.78	0.0

Figure 240. Bench-Scale Combustor Scheme 29-77A

First, additional testing was conducted to explore more fully the effect of primary-zone residence time on minimum NO_x attainable. Several configurations were used to generate these data. Figures 208, 210, 211, 217, and 219 depict these schemes.

Several additional combustor designs (Schemes 29-58A, 29-59A, 29-60A, 29-61A, 29-65A, 29-67A, shown in Figures 220, 221, 222, 223, 227, and 239, respectively) were tested to more fully document the effect of primary-zone residence time on the minimum attainable NO_x concentration level. A plot of the results is presented in Figure 230. Curves are included for neat No. 2 fuel, and for No. 2 fuel with 0.5% bound nitrogen (as pyridine). As expected, the functional dependence of the minimum attainable NO_x concentration on primary-zone residence time was more pronounced in the case of the nitrogen-bearing fuel. A residence time greater than 0.02 sec is evidently required to maintain the minimum NO_x concentration at levels below 100 ppmv in bench-scale burners when fuels containing 0.5% nitrogen are burned. A residence time greater than 0.10 sec is required to maintain the NO_x concentration below 50 ppmv.

Several data points did not fall directly on the curves drawn in Figure 230. Those at 0.72 and 0.113 sec were obtained at values of liner pressure drop above and below the nominal values of 4%. Liner pressure drop was varied by increasing and decreasing burner airflow while holding the burner configuration fixed (total open hole area constant). It is hypothesized that the increases in NO_x measured in these tests were due to off-design-point operation of the premixing tube rather than variations in turbulent mixing inside the combustor. At the low airflow setting (low pressure loss), the air velocity in the premixing passage is reduced, and fuel atomization is poorer (lower fuel nozzle flowrate and pressure drop); these two changes can cause a severe decline in the quality of preparation of the fuel-air mixture. Similarly, at the high airflow setting (high pressure drop), the increased flow of fuel can cause an overloading of the premixing passage, with a resultant decline in mixture quality. The data points at 0.30 sec were obtained in tests of the 6-inch dia primary liner. While the NO_x concentrations measured using this liner were not exceedingly high, it seemed unlikely that the greatly increased primary-zone residence time afforded by a larger diameter would result in an increased concentration level. In keeping with this view, the curves in Figure 230 have been drawn well below the actual data appearing at 0.30 sec (dashed extensions of the curves from lower values of the primary-zone residence time). It is believed that the 6-inch dia primary- zone liner represents a departure from optimum design practice, in particular that the 1.5-inch dia swirler at the discharge plane of the premixing passage was too small in relation to the 6-inch dia liner, with the result that only a portion of the available cross-sectional area of the primary zone was effectively used.

Several tests were again conducted for the purpose of gaining further experience in fuel-air premixing using the schemes shown in Figures 206 through 212, and 219. The basic combustors were essentially the same, and the results indicated the following: (1) the original style premix tube with central injector and exit swirler performed the best; (2) the length of the original tube could be shortened significantly (compare Figures 208 and 210) without an increase in NO_x, indicating that sufficient premixing and prevaporization had taken place in the short premix tube and that any NO_x initially formed due to nonhomogeneity in the fuel-air mixture had been consumed in the available primary-zone residence time; (3) it was possible to increase the size of the premix tube (Figure 219), allowing an increase in the quantity of airflow admitted to the primary zone without adversely effecting NO_x; (4) premix tubes utilizing inlet swirlers, while offering the potential of a more conservative design from the standpoint of pre-ignition within the premixing passage, had demonstrated poorer emission characteristics than their exit swirler counterparts; (5) the importance of good fuel-air preparation for the very low NO_x concentration levels demonstrated with the Rich Burn/Quick Quench combustor concept.

g. Quick Quench Investigation

Tests were also conducted to determine the latitude available in designing the quick-quench dilution zone. The dilution zone must provide strong mixing, so that an abrupt termination of the primary-zone rich-burning process can be achieved. It had been shown that the contraction from a 5-inch dia primary-zone section to a 3-inch dia dilution section in the bench-scale burner configuration was instrumental in providing the strong mixing required (the results of Schemes 29-50A and 29-52A, Figures 212 and 214, respectively, may be found in Appendix A). However, the shape of the dilution holes had been shown to be optional. Round holes, as used in Scheme 29-51A, were found to be equally effective as the elongated slots as used in Scheme 29-48A in the bench-scale tests. Also, it was shown that the diffuser downstream of the quick-quench zone, as in Scheme 29-48A (Figure 210), was unnecessary. It was concluded that the thermal NO_x formed in the recirculation region of the sudden expansion in Scheme 29-50A (Figure 212) was of negligible proportion.

Mixing effectiveness produced by the quick-quench zone was previously observed to be compromised by injecting the quench airflow without the benefit of a reduced burner diameter. Reference is made to Scheme 29-52A, Figure 214, where NO_x concentration levels of this combustor (without a reduced diameter quench region) were significantly higher than measured with the baseline Rich Burn/Quick Quench combustor (with a cross-sectional area constriction ratio of 0.36). In an attempt to determine whether a further reduction of the quench zone diameter (to a constriction ratio of 0.16) would further increase the mixing effectiveness and lower NO_x emissions, Scheme 29-72A, shown in Figure 235, was tested. The minimum NO_x achieved at the bottom of the bucket for this configuration was found to be higher than the baseline. This result suggested that an optimum constriction ratio in the bench-scale hardware was around a value of 0.36.

h. Primary Liner Cooling

Because of the importance of eliminating nonpremixed air from the primary zone, cooling considerations become more critical. The schemes depicted in Figures 215, 216, and 218 were initial attempts to convectively cool an inner liner by forcing airflow between the inner liner and an outer liner, discharging the spent cooling air into the quick-quench holes.

Analytical examinations of primary liner cooling methods not requiring the discharge of spent cooling air into the rich combustion region (primary zone) of the burner had been conducted in parallel to the test program and had revealed that an impingement/convection technique might hold an advantage (from the standpoint of increased cooling effectiveness) over the two convection techniques previously employed. Bench-scale hardware was constructed from an analytical design to investigate the feasibility of impingement cooling techniques. The burner configuration is shown in Figure 225. The primary liner consisted of a double-wall section made up by concentric cylindrical/conical pieces. The outer piece contained a plurality of small holes through which the liner cooling airflow enters, impinging on the surface of the inner piece. The annular passage between the pieces lead to the dilution section of the burner, where spent cooling air was discharged through the quick-quench slots. In the initial test of this configuration, failure of the inner liner wall occurred. Examination of the hardware following the test indicated that the longitudinal ribs separating the inner and outer pieces had constrained the inner wall, preventing thermal expansion. As a result, buckling of the inner wall occurred, and the effectiveness of the impingement cooling technique was compromised, leading to failure.

A second impingement cooling scheme was constructed in which attempts were made to improve the deficiencies found in the first design. The second design eliminated the longitudinal ribs and increased the impingement hole diameter slightly. This configuration is shown in Figure 233. Upon testing this configuration, failure of the inner liner was again experienced. Hardware examination indicated that this time circumferential buckling had occurred, presumably due to the prevention of thermal expansion of the inner liner in the axial direction, since the inner liner was rigidly affixed to the outer liner for support. From this experience it was concluded that if impingement cooling techniques were to be used, several design improvements would need to be implemented: (1) the inner liner to outer liner gap height must be maintained for uniform cooling effectiveness; (2) the inner liner must not be constrained from thermal growth, which implies that rigid affixment to any relatively cool structure should be avoided; (3) possible use of a more rigid, perhaps thicker walled, inner liner should be explored.

Further primary zone cooling analysis was conducted using two convection schemes. The first, Scheme 29-73A (shown in Figure 236), incorporated swirl vanes at the cooling passage entrance to explore the effectiveness of a swirl cooling technique. The other configuration, Scheme 29-76A (Figure 239), was essentially the same combustor without the cooling passage swirl vanes. The tests conducted indicated that there was no appreciable difference in the cooling effectiveness of the two schemes. The data generated in these experiments were used as a standard of comparison for analytical model predictions with regard to the influence of burner airflow rate, inlet pressure, and inlet-air temperature on primary-zone liner temperature level. A complete description of the test results and model predictions can be found in Section 2.5 of Volume III of this report.

i. Multiple Premix Tubes

Multiple premix tubes hold an advantage over a single tube in that a more uniform distribution of the fuel-air mixture, and a more effective utilization of the available volume in the primary zone of a combustor can be effected by introducing the fuel and air at a number of different locations rather than at a single site. To determine whether the use of multiple premix tubes might compromise the emission characteristics of the Rich Burn/Quick Quench combustor, an exploratory test was conducted in the bench-scale rig. A configuration having two small premixing tubes (Scheme 29-58A, shown in Figure 220) was compared to a second configuration having a single large premixing tube (Scheme 29-57A, shown in Figure 219). Total front-end airflow was the same in each combustor, and the two configurations were identical in all other respects. There were no major differences between the emission characteristics of the two schemes. A slightly higher NO_x concentration (60 vs 54 ppmv) was measured at the bottom of this NO_x curve "bucket" in the dual-tube combustor; however, this difference was no greater than a reasonable experimental error.

j. Further Tests of Alternative Dilution Scheme

A reduced diameter quick-quench section had been used in most configurations of the Rich Burn/Quick Quench combustor. An alternative design was previously described, which drew airflow through a centertube and discharged it as quench air in a radially outward direction. The results showed that NO_x concentration levels were higher. It was reasoned that the quenching process was ineffective due to low mainstream velocities. In an attempt to further explore this alternative method of quick-quench air addition, and to restore the quenching effectiveness, three additional combustor designs (Schemes 29-62A, 29-64A, and 29-66A, shown in Figures 224, 226, and 228, respectively) were tested. The arrangement was similar to conventional combustors which have a centertube structure designed to promote more effective mixing. The first configuration (Scheme 29-62A) tested showed that rich combustion in the primary zone could not be achieved at a reasonable overall equivalence

ratio. The quick-quench slots were enlarged (Scheme 29-64A), and retesting showed the same results. A series of holes were added to the exterior liner to supplement the airflow from the centertube slots (Scheme 29-66A). The test results obtained using this alternative method of quench air addition were not encouraging. While a rich primary zone was established, a NO_x concentration of about 84 ppmv (corrected to 15% O_2) was measured at the minimum point of the NO_x curve. This concentration was about 24 ppmv higher than the level measured previously in a comparable combustor having the reduced diameter quick-quench section.

It was concluded that the centertube arrangement of quick quench airflow addition, even with a reduced cross-sectional area, did not function as well as the baseline (reduced diameter) device. While the reasons for this were unclear, it was thought that perhaps the increased surface area of the annular passage might adversely affect the trade off between jet penetration and proper dilution air coverage, thereby compromising the quenching process.

k. Shale Derived Fuel

A shale-derived fuel having a nitrogen content of approximately 0.24% by weight was fired in two series of tests of the Rich Burn/Quick Quench combustor. These tests were designed to provide a comparison between No. 2 fuel with pyridine additive, which was used routinely in the bench-scale program, and a naturally nitrogeneous fuel (containing heavier nitrogen compounds). The shale fuel, which meets the basic specifications of Diesel Fuel Marine, was made available to this program by the Naval Ship Research and Development Center, Annapolis, Maryland.

The results of the tests were regarded as inconclusive. The NO_x concentration levels obtained using the shale fuel (0.24% N) were nearly identical to those obtained using No. 2 fuel with 0.5% nitrogen as pyridine. This outcome was not unreasonable in itself (if the heavier nitrogen compounds contained in the shale fuel take longer to burn, proportionately more NO_x might be produced in a given combustor). However, an unusually high NO_x concentration level (about 100 ppmv, corrected to 15% O_2) was recorded for both fuels. This level was 100% higher than the 50 ppmv level ordinarily measured for No. 2 fuel with 0.5% nitrogen as pyridine. A result of this kind raised the question of improper functioning of the combustor; in particular, a question of possible deterioration in the quality of fuel preparation, as can occur due to partial clogging of the fuel nozzle with the heavy earth waxes contained in the shale fuel.

l. Alternative Premix Tube Design

The alternative premixing module that had been proposed as an alternative fuel preparation device for use with the Acurex catalytic combustor (which was tested successfully under fuel-lean operating conditions as described earlier) was tested in combination with the basic Rich Burn/Quick Quench combustor in a single test series. The configuration, designated Scheme 29-68A, is shown in Figure 231. Although previous tests had shown that this premixing tube arrangement performed poorly under the fuel-rich conditions required for operation of the Rich Burn/Quick Quench combustor, revisions to the configuration (an increase from four to eight in the number of fuel injectors) seemed to offer some potential for improved performance. The combustor was operated on JP5 fuel (No. 2 fuel was temporarily out of stock), and on No. 2 fuel with 0.5% pyridine. Performance was poor, as it had been in the previous tests. The minimum attainable NO_x concentration was 128 ppmv (at 15% O_2) with the nitrogeneous fuel. Once again, the results seemed to indicate overloading of the premixing tube, with fuel impinging on the inside surfaces of the passage.

m. Secondary Zone Residence Time

A brief series of tests was conducted to generate data revealing the tradeoff between secondary zone length and CO concentration levels. Results from burner Schemes 29-71A, 29-74A, 29-75A, and 29-77A, shown in Figures 234, 237, 238, and 240, respectively, were used primarily for this purpose. A plot of CO concentrations measured at the minimum of the NO_x curve "bucket" (primary-zone equivalence ratio of approximately 1.3) for several secondary-zone residence times* is presented in Figure 241. It is evident from this figure that the CO oxidation process is a gradual one which depends (as expected) upon two major parameters: secondary-zone residence time; and secondary-zone equivalence ratio (and consequently, the resulting temperature). From these results it was estimated that a cold residence time in excess of 50 ms would be required to reach a CO concentration level of 100 ppmv (corrected to 15% O_2), if the equivalence ratio within the secondary zone were on the order of 0.3. With an increase in secondary equivalence ratio to around 0.4, much less time would be required for the oxidation of CO at the burner design point. Secondary-zone equivalence ratio was increased without affecting primary-zone equivalence ratio through the use of a larger premix tube (Scheme 29-77A). This caused primary-zone residence time to be reduced somewhat, but not enough to affect NO_x. Increasing the secondary-zone equivalence ratio had little or no effect on the measured NO_x concentrations at the design point. Further discussion of residence time considerations may be found in Section 2.6 of Volume III of this report.

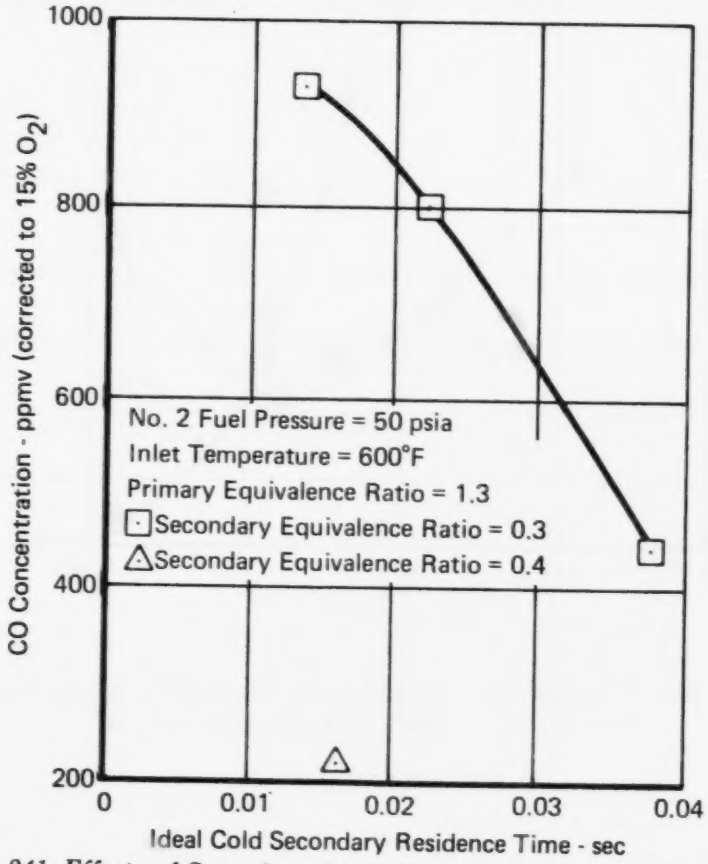


Figure 241. Effects of Secondary Zone Residence Time and Equivalence Ratio on CO Emissions

*Residence time based on inlet temperature and fully developed, fully attached flow in the secondary zone. Note that the actual cold residence time would be less due to the high-velocity, nonattached jet exiting the quick-quench zone.

n. Low-Btu Gaseous Fuel

Tests of the Rich Burn/Quick Quench concept were also conducted using a low-Btu gaseous fuel. The arrangement of the bench-scale hardware, Scheme 29-69A, is shown in Figure 232. The exhaust emission data, and the composition of the synthetically prepared gaseous fuel mixture are shown in Figure 242 and in Figure 243. The emission characteristics of the combustor, measured for low-Btu gaseous fuel, were very similar to those obtained previously with the nitrogeneous distillate fuel. A minimum NO_x concentration of about 80 ppmv (uncorrected — note the values tabulated in Appendix A were corrected to 15% O_2) was measured at the bottom of the "bucket" in the NO_x curve. By varying the primary air setting (which was not attempted in the tests conducted), it should be possible to achieve this same concentration level at any desired operating point over a wide range of overall equivalence ratios, in keeping with the results of staging tests conducted for the same concept using the distillate fuels.

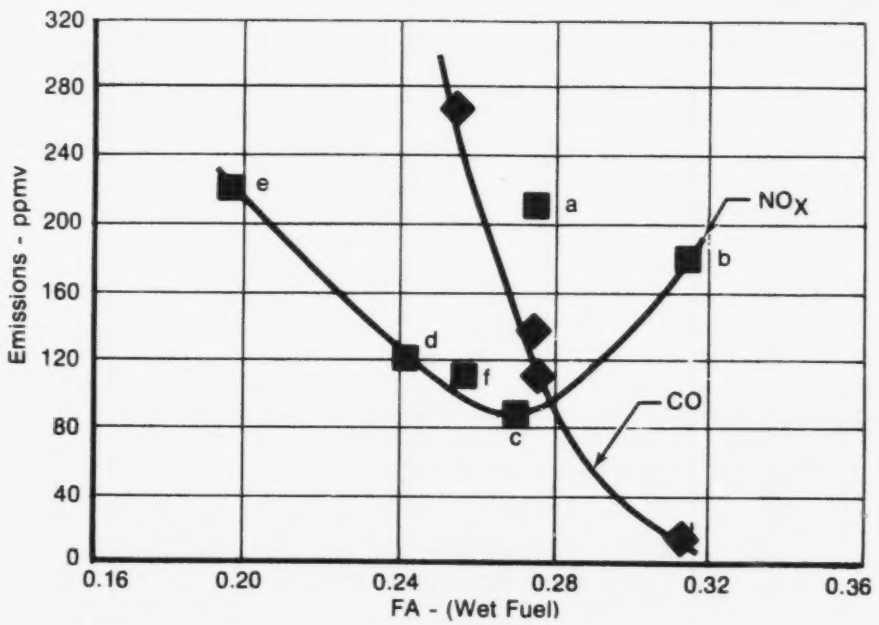


Figure 242. Variation in Emission Concentrations With Fuel-Air Ratio for Tests Conducted With Low Btu Gaseous Fuel

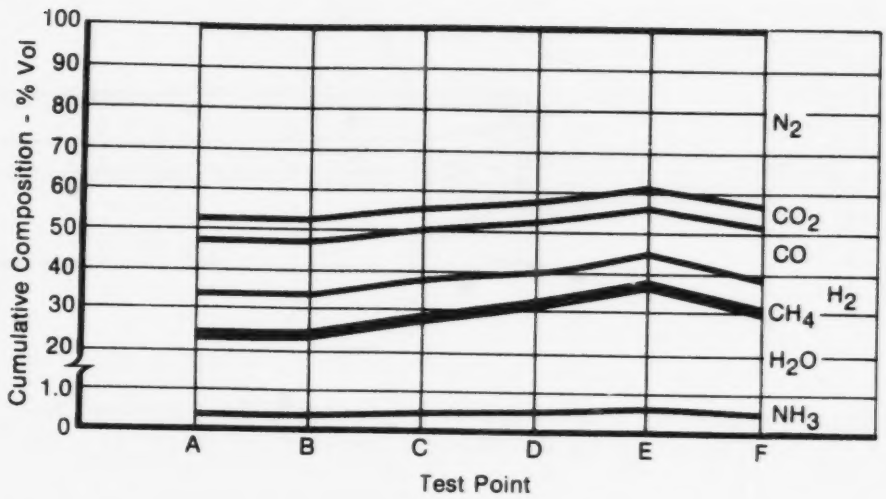


Figure 243. Variation in Emission Concentrations With Fuel-Air Ratio for Tests Conducted With Low-Btu Gaseous Fuel

3.4 ANALYTICAL MODEL SIMULATIONS

In a parallel analytical modeling effort (Task 2 of Phase II - Model Update), simulations of a successful lean-front-end burner (Concept No. 7 - Staged Centertube Burner), and of a successful rich-front-end burner (Concept No. 29 - Rich Burn Quick Quench) were carried out.

3.4.1 Simulation of Staged Centertube Burner — Concept No. 7

The staged centertube burner was modeled using the General Emissions Prediction Deck in the annular burner made with bluff-body flame stabilization. The modeling of this can-type burner as an annular configuration was done in order to allow the centertube airflow to be treated as dilution air entering from the inner liner. The model input parameters, including burner inlet airflow, temperature, pressure and airflow distribution, were chosen to duplicate the experimental conditions as closely as possible. The streamtube nomenclature and relative positions are shown in Figure 244. Streamtubes 4 and 6, in general, contain the inner and outer liner cooling flows respectively, which in this case are zero and thus not shown in the figure. Region 1 is the bluff-body-induced recirculation zone. The airflow in each streamtube is specified as model input and the streamtube radii are determined by the condition of equal flow per unit area.

The fuel is assumed to be fully vaporized at station X=0 and is injected equally into streamtubes 2A and 2B. The fuel-air ratio in the recirculation zone was set to 0.035 to simulate the lean front-end of the actual burner. The burner length input was made 12 inches greater than the actual burner length in order to simulate the effect of the exhaust duct in the test stand between the burner exit and the plane of the sampling probes. It was found that at higher fuel-air ratios (f/a = 0.020) this additional length reduced the predicted CO and HC emissions slightly. Additional length beyond this 12 inches had negligible effect on the emissions.

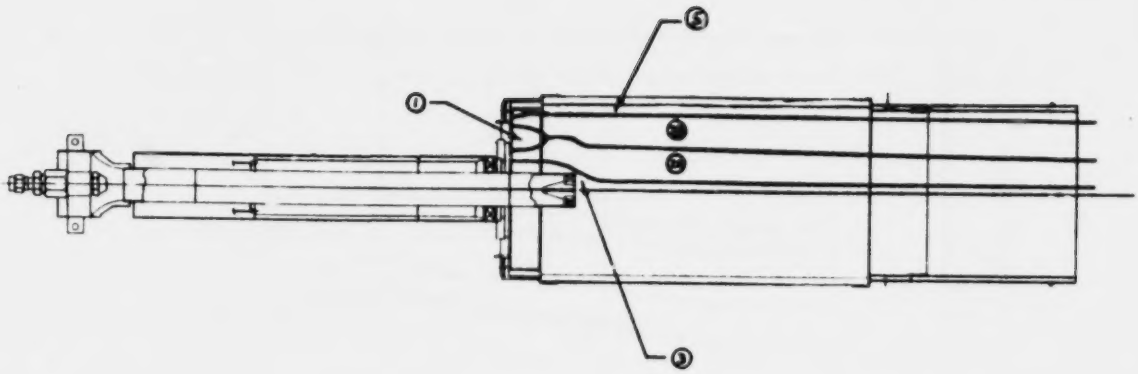


Figure 244. Location of Streamtubes for Analytical Simulation of Concept 7 — Staged Centertube Burner

This arrangement was evaluated over a range of fuel-air ratios from 0.010 to 0.021 with a centertube length of 1.5 inches. The NO_x and CO emissions corrected to 15 percent oxygen are plotted in Figure 245 as smooth curves along with some experimental data for comparison. There is good agreement between the analytical and experimental results. The length of the centertube was increased during this computer simulation to 5 inches with only a few ppm changes in the NO_x emissions and no change in the CO emissions. This effect was verified by experimental data.

3.4.2 Simulation of Rich Burn/Quick Quench — Concept No. 29

The modeling effort was extended to include the Rich-Burn/Quick Quench concept, which was treated as a can burner with a swirl stabilized pilot. In the actual burner, the quenching is accomplished by slots or holes located in the throat of a converging-diverging section. The rapid quenching rate which these dilution parts afford was involved by reducing the effective hole diameter since the model assumes complete mixing of dilution air within 10 diameters.

The actual hardware involved a premixing-prevaporizing section upstream of the pilot swirler. The extent of the fuel prevaporization had not been experimentally determined but was believed to have been nearly complete at low fuel flows. In the model, the fuel was arbitrarily assumed to be 25 percent prevaporized at a fuel flow corresponding to an overall fuel-air ratio of 0.021. This equivalent mass of fuel vapor is held constant at lower fuel flows until it corresponds to 100 percent prevaporization. Subsequent variation of the degree of prevaporization at various fuel-air ratios shows that 25 percent at f/a eq 0.021 yields the minimun NO_x formation. As in previous cases, additional burner length was employed in the model to simulate the effect of the exhaust duct between the end of the burner can and the plane of the sampling probes. Also, the leakage airflow which occurred at the rear attachment plate of the burner was modeled as dilution airflow into streamtubes 3 and 4 at an axial position corresponding to the rear of the real burner.

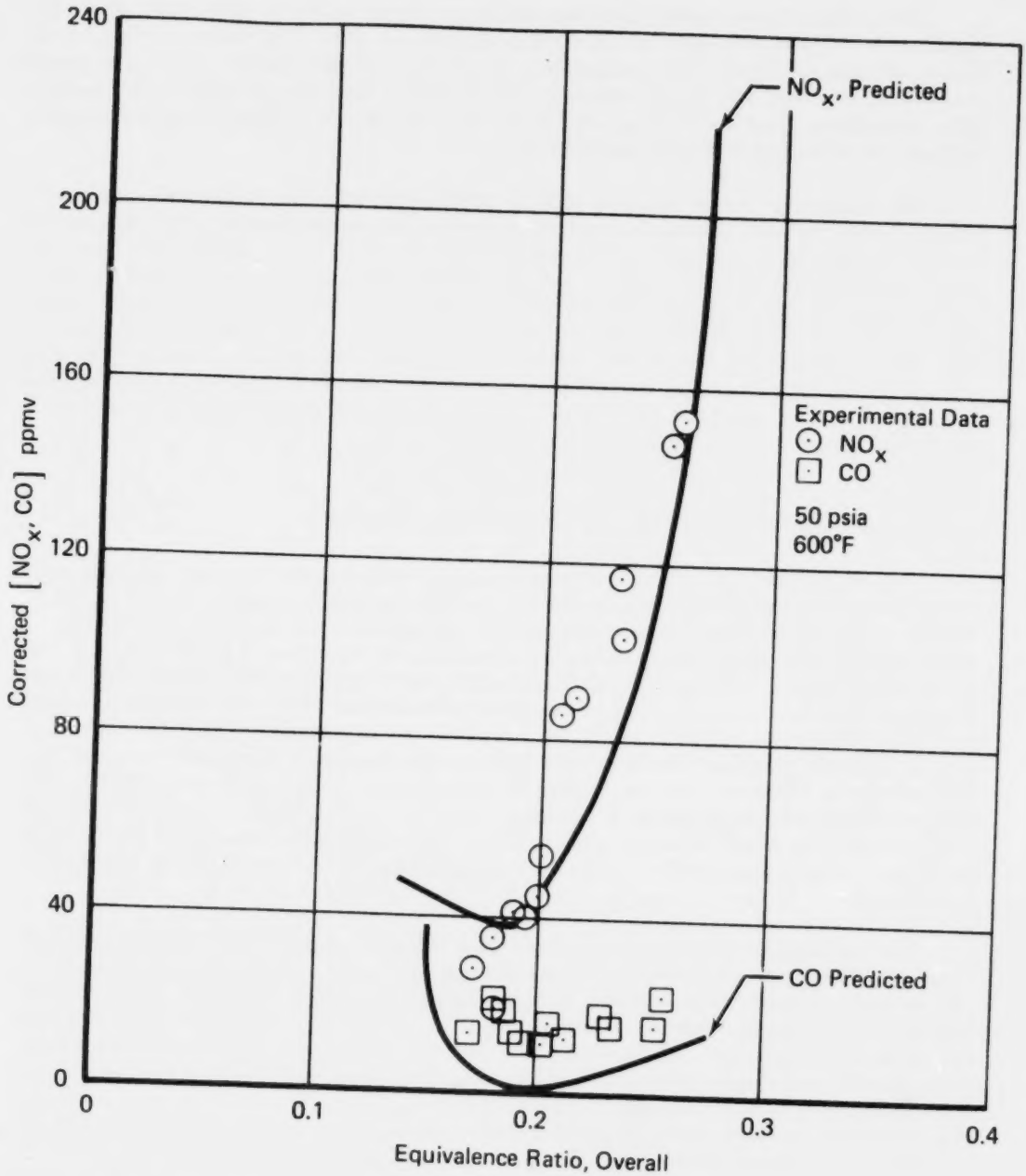


Figure 245. Comparison of Predicted and Experimental Emission Data, Concept No. 7 — Staged Centertube Burner

The results of these initial modeling efforts are shown in Figure 246, which shows the variation in CO and NO_x with overall burner equivalence ratio. The model predictions are shown as smooth curves. For comparison, actual data is also shown. For these model predictions, the front-end burner airflow is 12.4 percent of total burner airflow. This yields a pilot equivalence ratio of 1.0 at an overall fuel-air ratio of 0.010. There is good agreement between the analytical and experimental results.

The streamtube model was also used to predict the influence of primary zone louver cooling airflow on NO_x emission concentrations, and to determine whether preheated cooling airflow (as might be discharged from convective cooling passages in the primary zone liner) can be admitted through the dilution slots without compromising the low-emission characteristics of the burner. Results indicated that the diffusion burning which occurs in the mixing region between the premixed flame and the cooling streamtube can be a significant contributor to high NO_x concentration levels. The streamtube analytical model also predicts that this sensitivity may be confined to the upstream end of the primary zone however, and suggests that louver cooling can be employed in the rear portion of the primary zone without a significant impact on NO_x emission concentrations.

o. Summary of Concept No. 29 — Rich Burn/Quick Quench

Rich Burn/Quick Quench is a descriptive title indicating the intended approach embodied in this concept. Consecutive zones of : (1) rich burning to suppress the formation of NO_x by virtue of low flame temperatures and low concentrations of available oxygen; and (2) very rapid dilution to fuel-lean combustion to preclude NO_x formation in the transition. It was found that the rich burning zone should be supplied with a mixture of fuel and air of sufficient homogeneity to ensure that the bulk of the combustion process would take place under locally fuel-rich conditions. A deterioration in the quality of fuel-air preparation was shown to result in increased NO_x emissions. Similarly, the dilution effectiveness of the quench zone was also determined to influence NO_x formation. A deterioration in the quenching effectiveness produced increased NO_x emissions. It was also shown that all the airflow admitted into the rich zone needed to be mixed with fuel prior to entry. This meant that conventional liner cooling techniques (usually louvers which inject a film of air along the wall) could not be used for the primary zone.

The basic emission signature of the combustor (obtained experimentally by maintaining a constant airflow setting and varying the fuel flowrate) is illustrated in the data shown in figure 165. Attention should be focused first on the CO curve. Beginning at the left, CO is initially high because of lean blowout in the primary zone. The CO concentration level declines as the fuel flowrate is increased to achieve a higher overall equivalence ratio. Moving toward the right, the CO curve passes through a minimum point at about 0.08 overall equivalence ratio. This corresponds to the attainment of efficient burning in the primary zone, at a relatively low, uniformly lean, local equivalence ratio. At this condition, the flame temperature is too low to form an appreciable concentration of CO by thermal dissociation of CO_2. Moving further to the right however, the CO concentration increases sharply as the primary zone equivalence ratio increases and passes through stoichiometric, becoming fuel rich. The large quantities of CO produced in the primary zone under these conditions are frozen by the rapid quenching of the dilution slots, resulting in the very high CO concentration peak (nearly 1000 ppmx). As the fuel flowrate is increased further, the consumption of CO in the dilution zone begins to take place, and the concentration declines to a low level.

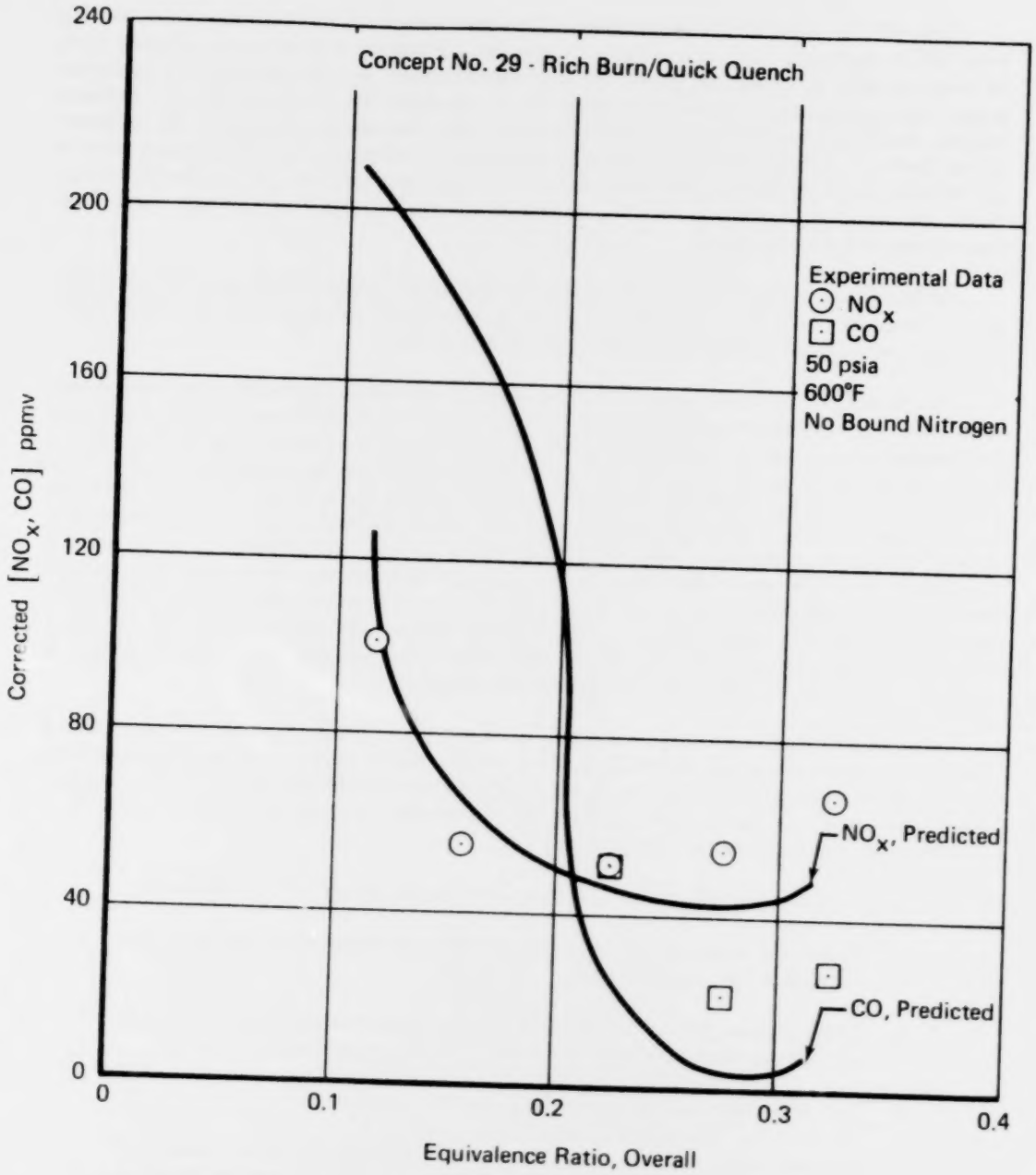


Figure 246. Comparison of Predicted and Experimental Emission Data, Concept No. 29 — Rich Burn/Quick Quench

The NO_x curve reflects the same internal processes that have just been described. Moving from left to right, the NO_x concentration increases and reaches a peak as the primary zone equivalence ratio increases and passes through stoichiometric. It then declines to a minimum point, which corresponds to fuel-rich p. imary zone operation. By increasing the fuel flowrate further, the NO_x concentration is made to increase again, because of a decline in the influence of the fuel-rich primary zone and a general transition of influence from the primary zone to the dilution zone. In the dilution zone, where conditions are fuel lean (on an overall average basis) the rate of production of NO_x escalates sharply as the fuel flowrate (and local equivalence ratio) is increased.

While there is the potential for smoke formation at primary zone equivalence ratios greater than about 1.5, the smoke data obtained indicated that operation near the design point (1.3) produced smoke numbers well below the visible range.

While the basic emission signature of the concept indicates a single operating point where both NO_x and CO concentrations are low (a range for clean fuels), a gas turbine combustor experiences a multitude of operating conditions determined by power setting. It was demonstrated that the optimum primary zone equivalence ratio could be maintained over a wide range of conditions by employing variable geometry, to stage the quantity of airflow admitted to the primary zone, in proportion to the fuel flow. The CO characteristic of the burner was shown to remain essentially fixed as primary zone airflow was varied. It is in essence dependent upon the equivalence ratio (temperature) within the secondary zone. This implies the need for a final dilution flow later in the secondary zone to allow residence time at a higher temperature for CO consumption. It also implies varying the quench flow for the ideal implementation of the concept. Variable quench flow is not necessary unless the combustor is intended to operate at extremely low equivalence ratios.

Gas turbine combustors also experience a range of inlet pressures, which in conventional (lean) combustors has a very substantial effect on the NO_x formed. It was demonstrated that there is no pressure effect on NO_x with the Rich Burn/Quick Quench concept. CO concentrations were shown to significantly decline with increasing pressure as expected since it is controlled by the fuel-lean secondary zone.

A certain amount of parametric information was also generated. In summary:

1. There is a trade-off between primary zone residence time and minimum achievable NO_x concentration.

2. There is also a trade-off between secondary zone residence time, secondary equivalence ratio at the design point, and CO concentrations attained.

3. Deficient fuel preparation results in increased NO_x.

4. Deficient quenching results in increased NO_x. From the bench scale configurations tested, the best method of quenching was a reduced diameter section with radial jet penetration. A cross-sectional area constriction ratio of about 0.36 was found to perform the best.

5. Swirl flame stabilization was found to be the best, probably due to more effective utilization of combustion volume available.

6. Round holes appeared to be equally effective in quenching as elongated slots.

7. A sudden expansion after the quick quench zone was determined not to significantly affect the NO_x formed in the secondary zone when compared to the gradual diffuser used initially.

The Rich Burn/Quick Quench combustor design concept was determined to have the potential of meeting all the program exhaust emission goals while operating not only on non-nitrogenous fuels, but also on fuels containing significant quantities of chemically bound nitrogen. It was concluded that, based on the superior performance demonstrated, the Rich Burn/Quick Quench concept should be the single design committed to full-scale hardware of a size representative of a 25 megawatt gas turbine engine.

SECTION IV

CONCLUSIONS FROM PHASE II

Specific comments and conclusions about each of the 29 NO_x reduction candidates were made within the applicable part of subsection 3.3. General comments concerning the overall efforts of the Phase II experimental program are offered here:

1. Bench-scale experimental screening proved to be a valuable tool for evaluating a large number of candidate NO_x reduction concepts. It also revealed new avenues of approach which were not identified initially. For example, Concept No. 29, Rich Burn/Quick Quench, was evolved from a similar concept, Quench Reheat.

2. The experimental screening efforts demonstrated that the NO_x reduction potential of two concepts could meet the program emission goals. One approach involved use of the Staged Centertube Burner (a lean, premixed configuration employing fuel staging) which was shown to be capable of meeting the program emission goals when operating on non-nitrogenous fuels. The other approach was the Rich Burn/Quick Quench concept. With this concept, the ability to meet the program goals when operating on either non-nitrogenous fuels or fuels with significant quantities of chemically bound nitrogen (specified as up to 0.5% wt in the program) was demonstrated.

3. The Rich Burn/Quick Quench design (Concept No. 29) was chosen as the single concept to be transferred to full-scale hardware in Phase III because of the multifuel (clean and nitrogenous) capability and the superior performance demonstrated.

REFERENCE

1. Mador, R. J., and Roberts, R., "A Pollutant Emissions Prediction Model for Gas Turbine Combustors," AIAA Paper No. 74-1113, 10th Propulsion Specialists Conference, San Diego, California, October 1974.

APPENDIX A

Tables	*Description*	*Page*
A-1	Combustor Operator Parameter Data	A-4
A-2	Emission Concentration and Gas Analysis Parameter Data	A-39
A-3	Combustor Liner Temperature Data and Fuel Air Ratio Information	A-76
A-4	Special Parameters — Heat Exchanger Information	A-113
A-5	Special Parameters — Pressure Drop and Airflow Rate Data	A-116
A-6	Special Parameters — Low Btu Gas Temperature	A-118
A-7	Special Parameters — Cooling Scheme Data	A-119
A-8	Special Parameters — Aero/Thermal Flow Modeling Data	A-120
A-9	Special Parameters — Smoke Data	A-121

DEFINITION OF PARAMETERS USED IN APPENDIX A TABLES

Parameter	*Definition*
Scheme	Concept No. — Configuration No. — Test Point No.
EQR	Overall equivalence ratio determined by measured fuel and airflow rates
PT3	Combustor inlet total pressure — (psia)
TT3	Combustor inlet total temperature — (°F)
LPL	Liner pressure loss (%)
Airflow	Airflow rate (lb_m/sec)
SHX	Inlet specific humidity
Fuel	Fuel type:
	2 — No. 2 distillate fuel oil
	2/0.5N — No. 2 distillate with 0.5% chemically-bound nitrogen as pyridine
	P — Propane
	M — Methane
	M+2 — Methane in Zone 1 and No. 2 distillate fuel oil in Zone 2
	G — Low-Btu gas
	5 — JP-5
	S — Shale derived DFM
HCQ15	Unburned hydrocarbon concentration in exhaust corrected to 15% O_2 (ppmv)
CMQ15	Carbon monoxide concentration in exhaust corrected to 15% O_2 (ppmv)
NXCQ15	Oxides of nitrogen, NO_x, concentration in exhaust corrected to 15% O_2 (ppmv)
CDQ1	Carbon dioxide concentration in exhaust (% volume)
OXQ1	Oxygen concentration in exhaust (% volume)
EFFGA	Combustion efficiency determined by gas analysis (%)

CFRAC	Carbon balance fraction determined from measured fuel and air against measured exhaust emission quantities
Note	Refers to nonrepresentative test conditions — see explanation at end of Table A-2
BST1 through BST4	Combustor wall temperatures — see scheme definition figures for locations (°F)
FASAM	Overall fuel-air ratio determined by sample gas analysis
FUAIR	Overall fuel-air ratio determined by measured fuel and airflow rates
FAOX1	Fuel-air ratio in Zone 1
FAOX2	Fuel-air ratio in Zone 2
Parameters in Table A-4 through A-9	Described at end of each table

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA

DATA TABLE . . . FINAL REPORT

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
01-05A-1	0.0845	50.0000	601.5000	2.6000	1.2692	0.0123	2
01-05A-2	0.1247	50.0000	603.0000	3.0000	1.2837	0.0123	2
01-05A-3	0.1750	50.0000	605.5000	3.0000	1.2772	0.0123	2
01-05A-4	0.1858	50.0000	598.5000	3.0000	1.2931	0.0123	2
01-05A-5	0.1415	50.0000	599.0000	2.8000	1.2622	0.0123	2
01-05A-6	0.1095	50.0000	609.5000	2.8000	1.2623	0.0123	2
01-06A-1	0.1123	50.0000	602.5000	3.2000	1.2721	0.0140	2
01-06A-2	0.1456	50.0000	603.0000	3.4000	1.2774	0.0140	2
01-06A-3	0.1780	50.0000	600.5000	3.4000	1.2813	0.0140	2
01-07A-1	0.1798	50.0000	600.0000	3.0000	1.2663	0.0132	2
01-07A-2	0.2252	50.0000	602.5000	3.0000	1.2718	0.0132	2
01-07A-3	0.1463	50.0000	603.5000	3.0000	1.2701	0.0132	2
01-07A-4	0.2786	50.0000	602.5000	3.0000	1.2686	0.0132	2
01-07A-5	0.3397	50.0000	598.5000	3.2000	1.2667	0.0132	2
01-07A-6	0.3896	50.0000	601.0000	3.2000	1.2828	0.0132	2
01-07A-7	0.2264	50.0000	601.0000	3.0000	1.2825	0.0132	2
01-07A-8	0.1779	50.0000	602.0000	3.0000	1.2789	0.0132	2
01-07A-9	0.1206	49.5000	602.0000	1.0101	0.8140	0.0132	2
01-07A-10	0.3971	50.0000	603.0000	1.0000	0.7210	0.0132	2
01-07A-11	0.1922	50.0000	598.5000	5.8000	1.7956	0.0132	2
01-07A-12	0.1431	50.0000	596.5000	2.8000	1.2804	0.0130	2/.5N
01-07A-13	0.1766	50.0000	603.0000	3.0000	1.2765	0.0130	2/.5N
01-07A-14	0.2291	50.0000	600.5000	3.0000	1.2780	0.0130	2/.5N
01-07A-15	0.2749	50.0000	601.5000	3.0000	1.2792	0.0130	2/.5N
01-07A-16	0.3283	50.0000	602.0000	3.0000	1.2759	0.0130	2/.5N
01-07A-17	0.3756	50.0000	599.5000	3.0000	1.2837	0.0130	2/.5N
01-07A-18	0.1489	50.0000	601.5000	3.0000	1.2831	0.0130	2/.5N
01-07A-19	0.2400	50.0000	602.0000	1.0000	0.7781	0.0130	2/.5N
01-07A-20	0.3243	50.0000	597.5000	1.2000	0.7715	0.0130	2/.5N
01-07A-21	0.3611	50.0000	607.5000	1.2000	0.8098	0.0130	2/.5N
01-07A-22	0.1690	50.0000	600.5000	1.2000	0.8488	0.0130	2/.5N
01-08A-1	0.1204	50.0000	598.0000	3.4000	1.5470	0.0094	2
01-08A-2	0.1752	50.0000	603.5000	3.6000	1.5419	0.0094	2
01-08A-3	0.2284	50.0000	597.5000	3.8000	1.5507	0.0094	2
01-08A-4	0.2829	50.0000	600.0000	3.8000	1.5478	0.0094	2
01-08A-5	0.3367	50.0000	601.0000	3.8000	1.5485	0.0094	2
01-08A-6	0.2295	50.0000	600.5000	3.8000	1.5405	0.0094	2
01-08A-7	0.2430	50.0000	603.0000	3.8000	1.5434	0.0094	2
01-08A-8	0.2997	50.0000	603.0000	3.8000	1.5459	0.0094	2
01-08A-9	0.3538	50.0000	599.0000	3.8000	1.5499	0.0094	2
01-08A-10	0.1833	50.0000	602.0000	3.6000	1.5448	0.0094	2
01-08A-11	0.2376	50.0000	598.5000	3.8000	1.5463	0.0094	2
01-08A-12	0.2953	50.0000	600.5000	3.8000	1.5452	0.0094	2
01-08A-13	0.3491	50.0000	601.5000	3.8000	1.5448	0.0094	2
01-08A-14	0.3938	50.0000	602.0000	3.8000	1.5459	0.0094	2
01-08A-15	0.4069	50.0000	599.5000	3.8000	1.5467	0.0094	2
01-08A-16	0.3355	50.0000	599.0000	3.8000	1.5463	0.0094	2
01-08A-17	0.1733	50.0000	599.5000	3.6000	1.5485	0.0094	2
01-09A-1	0.0934	50.0000	603.0000	3.6000	1.5326	0.0086	2
01-09A-2	0.1477	50.0000	597.5000	4.2000	1.5467	0.0086	2
01-09A-3	0.2029	50.0000	602.5000	4.2000	1.5398	0.0086	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
01-09A-4	0.2580	50.0000	602.0000	4.2000	1.5376	0.0086	2
01-09A-5	0.3121	50.0000	599.5000	4.4000	1.5391	0.0086	2
01-09A-6	0.3643	50.0000	596.5000	4.4000	1.5482	0.0086	2
01-09A-7	0.1195	50.0000	596.5000	4.0000	1.5558	0.0086	2
01-09A-8	0.1060	50.0000	597.0000	3.8000	1.5536	0.0086	2
01-09A-9	0.1204	50.0000	602.0000	3.8000	1.5463	0.0086	2
01-09A-10	0.1734	50.0000	603.0000	2.0000	1.0736	0.0086	2
01-09A-11	0.1116	50.0000	600.0000	1.8000	1.0825	0.0086	2
01-09A-12	0.2521	50.0000	603.0000	1.8000	1.0705	0.0086	2
01-09A-13	0.3109	50.0000	596.5000	2.0000	1.0710	0.0086	2
01-09A-14	0.3705	50.0000	600.0000	2.0000	1.0686	0.0086	2
01-09A-15	0.1965	50.0000	598.5000	7.4000	2.0121	0.0086	2
01-09A-16	0.3021	50.0000	602.5000	7.6000	2.0017	0.0086	2
01-10A-1	0.1207	50.0000	600.0000	3.6000	1.5406	0.0079	2
01-10A-2	0.1753	50.0000	603.0000	3.8000	1.5405	0.0079	2
01-10A-3	0.2297	50.0000	603.0000	4.0000	1.5410	0.0079	2
01-10A-4	0.2836	50.0000	598.5000	4.0000	1.5439	0.0079	2
01-10A-5	0.3344	50.0000	590.0000	4.2000	1.5580	0.0079	2
01-10A-6	0.3636	50.0000	602.0000	4.2000	1.5462	0.0079	2
01-10A-7	0.1211	50.0000	602.0000	3.6000	1.5428	0.0077	2/.5N
01-10B-8	0.3406	50.0000	604.5000	4.2000	1.5398	0.0077	2/.5N
02-01A-1	0.4672	46.0000	679.0000	0.8696	0.3230	0.0139	P
02-01B-1	0.3875	45.0000	693.0000	0.2222	0.1896	0.0038	P
02-01B-2	0.3469	73.0000	711.0000	0.0	0.1934	0.0038	P
02-01B-3	0.4062	73.0000	701.5000	0.0	0.1937	0.0038	P
02-01B-4	0.2627	99.5000	712.5000	0.0	0.2166	0.0088	P
02-01B-5	0.2360	147.5000	820.5000	0.0	0.5036	0.0088	P
02-01B-6	0.3624	45.5000	670.5000	0.0	0.1643	0.0088	P
02-01B-7	0.1753	44.0000	879.5000	0.0	0.3468	0.0093	2
02-01B-8	0.1956	44.5000	887.0000	0.0	0.3511	0.0093	2
02-01B-9	0.1669	76.5000	815.0000	0.0	0.7643	0.0093	2
02-01B-10	0.1618	103.0000	687.5000	0.0	1.0753	0.0093	2
02-01B-11	0.1295	43.5000	868.5000	0.0	0.3326	0.0093	2/.5N
02-01B-12	0.2699	45.0000	769.5000	0.0	0.3494	0.0103	2/.5N
02-01B-13	0.2468	74.5000	751.0000	0.0	0.6699	0.0103	2/.5N
02-01B-14	0.2512	99.2500	744.5000	0.0	0.8303	0.0103	2/.5N
03-03A-1	0.0819	50.0000	607.5000	3.1437	1.5347	0.0095	2
03-03A-2	0.0989	49.7500	607.0000	3.3569	1.5365	0.0095	2
03-03A-3	0.1129	50.0000	610.0000	3.3402	1.5358	0.0095	2
03-03A-4	0.1272	50.5000	612.5000	3.4044	1.5328	0.0095	2
03-03A-5	0.0989	49.2500	609.5000	3.2913	1.5354	0.0095	2
03-04A-1	0.0567	50.2500	611.0000	3.2258	1.5317	0.0029	2
03-04A-2	0.0737	50.5000	613.0000	3.4044	1.5311	0.0029	2
03-04A-3	0.0849	50.7500	616.5000	3.3876	1.5322	0.0029	2
03-04A-4	0.0993	51.0000	616.0000	3.4673	1.5288	0.0029	2
03-04A-5	0.1130	51.0000	614.5000	3.5636	1.5343	0.0029	2
03-04A-6	0.1273	50.0000	618.0000	3.6349	1.5336	0.0029	2
03-05A-1	0.0991	49.2500	621.0000	3.0918	1.5234	0.0156	2
03-05A-2	0.1127	50.2500	614.5000	3.0303	1.5322	0.0156	2
03-05A-3	0.1266	50.5000	617.0000	3.5989	1.5329	0.0156	2
03-05A-4	0.1402	50.6000	612.5000	3.6743	1.5383	0.0156	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
03-06A-1	0.0847	49.8500	612.0000	3.5473	1.5263	0.0149	2
03-06A-2	0.0533	49.2500	612.0000	4.1889	1.5372	0.0149	2
03-06A-3	0.0730	49.7500	616.3000	3.9493	1.5336	0.0149	2
03-06A-4	0.0843	49.7500	617.5000	4.0481	1.5322	0.0149	2
03-06A-5	0.0984	49.7500	616.5000	4.1468	1.5336	0.0149	2
03-06A-6	0.1124	49.9500	617.5000	4.3269	1.5329	0.0149	2
03-06A-7	0.0559	49.4500	613.5000	3.8740	1.5376	0.0149	2
04-01A-1	0.1030	15.0000	609.0000	2.2923	0.4039	0.0188	2
04-01A-2	0.2611	15.0000	613.5000	2.6197	0.4027	0.0188	2
04-01A-3	0.2659	15.0000	620.0000	2.6197	0.4012	0.0188	2
04-01A-4	0.1101	15.0000	611.5000	2.6197	0.4056	0.0181	2
04-02A-1	0.1281	15.0000	630.0000	2.6197	0.3802	0.0154	2
04-02A-2	0.3612	15.0000	617.5000	3.2747	0.3958	0.0154	2
04-02A-3	0.3253	15.0000	627.5000	2.9472	0.3905	0.0141	2
04-02A-4	0.3672	15.0000	627.5000	2.9472	0.3913	0.0141	2
04-02A-5	0.1487	15.0000	615.0000	3.9296	0.3795	0.0141	2
04-03A-1	0.0648	15.1000	615.0000	3.5783	0.3723	0.0132	2
04-03A-2	0.2291	15.1000	610.0000	4.2289	0.3741	0.0132	2
04-03A-3	0.1567	15.1000	615.0000	4.8795	0.4016	0.0132	2
04-03A-4	0.2113	15.0000	607.5000	4.9120	0.3830	0.0126	2
04-04A-1	0.0	14.8136	0.0	0.0	0.0	0.0099	2
04-04A-2	0.0	14.8136	0.0	0.0	0.0	0.0099	2
04-04A-3	0.0	14.8136	0.0	0.0	0.0	0.0099	2
04-05A-1	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-2	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-3	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-4	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-5	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-6	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-7	0.0	14.8288	0.0	0.0	0.0	0.0063	2
04-05A-8	0.0	14.7218	0.0	0.0	0.0	0.0132	2
04-05A-9	0.0	14.7218	0.0	0.0	0.0	0.0132	2
04-05A-10	0.0	14.7218	0.0	0.0	0.0	0.0132	2
04-05A-11	0.0	14.7006	0.0	0.0	0.0	0.0126	2
04-05A-12	0.0	14.7006	0.0	0.0	0.0	0.0126	2
04-05A-13	0.0	14.7606	0.0	0.0	0.0	0.0130	2
04-05A-14	0.0	14.7606	0.0	0.0	0.0	0.0130	2
04-05A-15	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-16	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-17	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-18	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-19	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-20	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-21	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-22	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-23	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-24	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-25	0.0	14.8421	0.0	0.0	0.0	0.0061	2
04-05A-26	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-27	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-28	0.0	14.8249	0.0	0.0	0.0	0.0081	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
04-05A-29	0.0	14.8249	0.0	0.0	0.0	0.0061	2
04-05A-30	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-31	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-32	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-33	0.0	14.8249	0.0	0.0	0.0	0.0081	2
04-05A-34	0.0	14.8249	0.0	0.0	0.0	0.0061	2
04-06A-1	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-2	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-3	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-4	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-5	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-6	0.0	14.7704	0.0	0.0	0.0	0.0128	2
04-06A-7	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-06A-8	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-06A-9	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-06A-10	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-06A-11	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-06A-12	0.0	14.8342	0.0	0.0	0.0	0.0056	2
04-07A-1	0.0	14.7743	0.0	0.0	0.0	0.0127	2
04-07A-2	0.0	14.7743	0.0	0.0	0.0	0.0127	2
04-07A-3	0.0	14.7743	0.0	0.0	0.0	0.0127	2
04-07A-4	0.0	14.7743	0.0	0.0	0.0	0.0127	2
04-07A-5	0.0	14.7743	0.0	0.0	0.0	0.0127	2
05-01A-1	0.1521	15.0000	596.0000	0.0	0.2292	0.0117	2
05-01A-2	0.2189	14.9000	630.0000	0.0	0.2322	0.0117	2
05-01A-3	0.2641	14.9500	635.0000	0.0	0.2446	0.0117	2
05-01A-4	0.3252	14.9000	629.0000	0.0	0.2421	0.0117	2
05-01A-5	0.3808	14.9000	621.5000	0.0	0.2371	0.0117	2
05-01A-6	0.3736	14.9000	624.0000	0.0	0.2416	0.0117	2
05-01A-7	0.3226	14.9000	634.0000	0.0	0.2413	0.0117	2
05-01A-8	0.3753	14.9000	626.5000	0.0	0.2406	0.0119	2
05-01A-9	0.3162	14.9000	631.5000	0.0	0.2461	0.0119	2
05-01A-10	0.2653	14.9000	623.5000	0.0	0.2447	0.0119	2
05-02A-1	0.1644	15.0000	659.0000	0.0	0.2344	0.0127	2
05-02A-2	0.3654	15.0000	647.5000	0.0	0.2390	0.0127	2
05-02A-3	0.3963	15.0000	760.0000	0.0	0.2150	0.0127	2
05-02A-4	0.8092	15.0000	775.0000	0.0	0.2063	0.0153	2
05-03A-1	0.1602	15.0000	787.5000	1.3099	0.2160	0.0152	2
05-03A-3	0.3111	15.0000	792.5000	1.6373	0.2105	0.0144	2
05-03A-3	0.4208	15.2500	802.5000	1.6105	0.2055	0.0144	2
05-04A-1	0.1698	60.0000	627.5000	1.6373	1.2775	0.0115	2
05-04A-2	0.2475	64.0000	625.0000	1.5350	1.3142	0.0115	2
05-04A-3	0.3061	60.5000	627.5000	1.8674	1.2755	0.0115	2
05-04A-4	0.2920	59.2500	634.0000	1.7410	1.2777	0.0115	2
05-04A-5	0.2128	56.7500	607.5000	1.9042	1.2839	0.0115	2
05-04A-6	0.2351	57.7500	600.0000	2.1264	1.2935	0.0115	2
05-04A-7	0.2701	60.0000	612.5000	2.0467	1.2978	0.0115	2
05-04A-8	0.2819	62.2500	607.5000	1.8149	1.3223	0.0115	2
05-04A-9	0.3111	63.5000	600.0000	1.9339	1.3308	0.0115	2
05-05A-1	0.2408	50.5000	612.5000	3.2098	1.5466	0.0162	2
05-05A-2	0.2190	49.6000	613.5000	3.3081	1.5445	0.0162	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
05-05A-3	0.1884	48.0000	617.5000	3.4793	1.5449	0.0162	2
05-05A-4	0.1383	48.0000	617.5000	3.3770	1.5481	0.0162	2
05-05A-5	0.1631	50.5000	617.5000	3.2098	1.5481	0.0162	2
05-05A-6	0.2772	48.2500	622.5000	3.2577	1.5445	0.0162	2
05-05A-7	0.1884	47.2500	620.0000	3.5346	1.5449	0.0151	2/.5N
05-05A-8	0.2469	49.5000	617.5000	3.4731	1.5433	0.0151	2/.5N
05-05A-9	0.2771	48.5000	617.5000	3.6460	1.5449	0.0151	2/.5N
05-05B-1	0.0560	48.7500	622.5000	3.7281	1.5385	0.0188	2/.5N
05-05B-2	0.0691	48.4500	600.0000	3.8525	1.5566	0.0188	2/.5N
05-05B-3	0.0477	49.2500	615.0000	3.7900	1.5358	0.0188	2/.5N
05-05B-4	0.0550	48.0000	592.5000	3.9910	1.5650	0.0183	2/.5N
05-05B-5	0.0697	48.2500	612.5000	4.1739	1.5452	0.0183	2/.5N
05-05B-6	0.0756	49.6000	619.0000	4.1100	1.5402	0.0183	2/.5N
05-05B-7	0.0470	48.0000	604.0000	4.0933	1.5547	0.0192	2
05-05B-8	0.0551	48.6000	602.5000	4.0933	1.5566	0.0192	2
05-05B-9	0.0691	48.7500	601.5000	4.1311	1.5549	0.0192	2
05-05C-1	0.1411	48.2500	607.5000	4.0721	1.5376	0.0099	2
05-05C-2	0.1963	49.0000	602.5000	4.5110	1.5522	0.0099	2
05-05C-3	0.2526	49.0000	612.5000	4.5110	1.5481	0.0099	2
05-05C-4	0.2280	48.5000	612.5000	4.5575	1.5442	0.0099	2
05-05C-5	0.2800	48.7500	607.5000	4.6349	1.5515	0.0101	2
05-05C-6	0.2932	49.3500	610.0000	5.0762	1.5479	0.0101	2
05-05C-7	0.2609	49.1500	613.5000	5.1968	1.5545	0.0101	2
05-05C-8	0.2420	48.0000	614.0000	5.5260	1.5520	0.0101	2
05-05C-9	0.2041	49.0000	612.5000	5.2127	1.5450	0.0101	2
05-05C-10	0.1990	47.5000	592.5000	5.1705	1.5420	0.0101	2/.5N
05-05C-11	0.2450	49.5000	622.5000	4.5647	1.5367	0.0101	2/.5N
05-05C-12	0.2760	50.7500	632.5000	4.5490	1.5450	0.0101	2/.5N
05-05C-13	0.3071	52.5000	600.0000	4.2103	1.5436	0.0101	2/.5N
05-05C-14	0.3153	53.7500	606.0000	4.1124	1.5387	0.0101	2/.5N
05-06A-1	0.1578	50.2500	602.5000	4.6921	1.5348	0.0181	2/.5N
05-06A-2	0.1874	49.7500	600.0000	5.0354	1.5444	0.0181	2/.5N
05-06A-3	0.1871	48.7500	602.5000	5.2395	1.5451	0.0151	2/.5N
05-06A-4	0.2210	50.0000	615.0000	5.2067	1.5412	0.0151	2/.5N
05-07A-1	0.2154	50.7500	615.0000	5.1298	1.5313	0.0112	2
05-07A-2	0.3103	50.5000	627.5000	5.6415	1.5299	0.0112	2
05-07A-3	0.0445	49.7500	617.5000	4.5417	1.5316	0.0112	2
05-07A-4	0.3084	49.7500	612.5000	5.7266	1.5394	0.0119	2
05-07A-5	0.3104	49.7500	622.5000	5.7266	1.5351	0.0119	2/.5N
05-07A-6	0.3358	49.7500	617.5000	5.8253	1.5384	0.0122	2
05-07A-7	0.2417	49.5000	626.0000	5.6562	1.5313	0.0122	2
05-07A-8	0.3171	50.2500	629.0000	5.6696	1.5218	0.0122	2
05-07A-9	0.2898	50.2500	625.0000	5.6696	1.5145	0.0110	2
05-07A-10	0.2185	49.7500	615.0000	5.5291	1.5364	0.0110	2
05-07A-11	0.1878	49.7500	612.5000	5.4303	1.5339	0.0110	2
05-07A-12	0.1564	49.5000	612.5000	5.1601	1.5339	0.0110	2
05-07A-13	0.1289	47.7500	604.0000	5.3492	1.5339	0.0110	2
05-07A-14	0.0299	49.5000	592.5000	7.9386	1.5456	0.0131	2
05-07A-15	0.0157	47.7500	602.5000	4.9377	1.5328	0.0134	2
05-08A-1	0.0151	50.2500	635.0000	2.9325	1.2302	0.0115	2
05-09A-1	0.0106	50.7500	610.0000	4.0651	1.5402	0.0119	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
05-09A-2	0.1841	49.7500	.604.0000	5.0354	1.5364	0.0119	2
05-09A-3	0.1917	50.2500	606.0000	5.0831	1.5332	0.0119	2
05-09A-4	0.2191	50.7500	605.0000	5.0330	1.5339	0.0119	2
05-09A-5	0.2855	50.7500	596.0000	5.0330	1.5432	0.0119	2
05-09A-6	0.3287	50.7500	595.0000	5.4201	1.5495	0.0119	2
05-09A-7	0.3203	50.5000	572.5000	5.3497	1.5720	0.0127	2/.5N
05-09A-8	0.2912	50.2500	602.5000	5.2786	1.5423	0.0127	2/.5N
05-09A-9	0.2297	50.7500	607.5000	4.9362	1.5387	0.0127	2/.5N
05-09A-10	0.2046	48.7500	612.5000	5.1387	1.5350	0.0127	2/.5N
05-09A-11	0.1324	50.2500	610.0000	4.3988	1.5351	0.0127	2/.5N
05-09A-12	0.1265	49.7500	610.0000	4.6405	1.5351	0.0127	2/.5N
05-09A-13	0.1439	50.7500	612.5000	4.5490	1.5293	0.0127	2/.5N
05-10A-1	0.1271	45.0000	605.5000	5.5669	1.5354	0.0063	2/.5N
05-10A-2	0.1600	49.7500	600.0000	4.7342	1.5108	0.0063	2
05-10A-3	0.2102	50.7500	604.5000	4.7426	1.5394	0.0074	2
05-10A-4	0.2684	50.2500	604.0000	4.8876	1.5339	0.0066	2
05-10A-5	0.2348	50.2500	604.5000	4.8876	1.5391	0.0066	2
05-10B-1	0.0140	49.5000	599.0000	3.9693	1.5366	0.0082	2
05-10B-2	0.0174	50.0000	587.0000	3.9296	1.5628	0.0082	2
05-10B-3	0.0202	50.2500	604.5000	4.1056	1.5408	0.0082	2
05-10B-4	0.0254	50.2500	603.5000	4.1056	1.5455	0.0082	2
05-10B-5	0.0313	49.7500	607.5000	4.1468	1.5418	0.0084	2
05-10B-6	0.0379	50.0000	608.0000	4.1261	1.5381	0.0086	2
05-10B-7	0.0438	50.2500	615.0000	4.2033	1.5353	0.0086	2
05-10B-8	0.0487	50.2500	605.0000	4.2033	1.5399	0.0086	2
05-11A-1	0.0224	50.0000	597.5000	4.3226	1.5563	0.0096	2
05-11A-2	0.0252	49.5000	619.5000	4.3662	1.5367	0.0094	2
05-11A-3	0.0135	50.2500	592.5000	4.3011	1.5543	0.0099	2
05-11A-4	0.0167	49.7500	605.5000	4.3443	1.5473	0.0099	2
05-11A-5	0.0193	50.2500	593.5000	4.3011	1.5561	0.0099	2
05-11A-6	0.0221	50.7500	598.5000	4.2587	1.5554	0.0099	2
05-11A-7	0.1165	50.2500	602.0000	4.8876	1.5525	0.0103	2
05-11A-8	0.1857	50.2500	601.0000	5.1808	1.5532	0.0103	2
05-11A-9	0.2379	50.2500	603.0000	5.5718	1.5541	0.0103	2
05-11A-10	0.0169	48.7500	608.0000	4.5342	1.5280	0.0149	2
05-11A-11	0.1138	50.7500	606.5000	4.8394	1.5462	0.0149	2
05-11A-12	0.1121	50.7500	606.0000	4.7426	1.5469	0.0141	2
05-11B-1	0.0166	50.7500	596.0000	4.3555	1.5529	0.0152	2
05-11B-2	0.2915	50.2500	611.0000	5.3763	1.5389	0.0146	2
05-11B-3	0.3191	51.2500	615.0000	4.9839	1.5389	0.0146	2
05-11B-4	0.2421	50.2500	599.0000	5.1808	1.5478	0.0146	2
05-11B-5	0.1830	49.2500	599.5000	5.2860	1.5543	0.0146	2
05-11B-6	0.1583	48.2500	600.5000	5.3956	1.5528	0.0151	2
05-11B-7	0.1170	49.2500	603.0000	4.9868	1.5502	0.0151	2
05-11B-8	0.1358	49.7500	606.0000	4.9367	1.5537	0.0151	2
05-11C-1	0.1357	49.2500	596.5000	5.0865	1.6565	0.0190	2
05-11C-2	0.0675	49.2500	608.5000	4.6876	1.6474	0.0181	2
05-11C-3	0.1200	50.2500	605.0000	4.8876	1.6440	0.0181	2
05-11C-4	0.1773	49.7500	605.5000	5.2329	1.6453	0.0181	2
05-11C-5	0.2283	50.0000	600.5000	5.2067	1.6541	0.0181	2
05-11C-6	0.2900	50.2500	608.0000	5.1808	1.5454	0.0281	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
05-11C-7	0.2678	49.2500	591.5000	5.3857	1.5420	0.0281	2
05-11C-8	0.1547	49.7500	609.0000	4.9367	1.5430	0.0163	2/.5N
05-11C-9	0.1811	49.7500	599.0000	5.2329	1.5566	0.0163	2/.5N
05-11C-10	0.2417	50.7500	606.0000	5.0330	1.5399	0.0163	2/.5N
05-11C-11	0.2972	50.7500	602.5000	5.4201	1.5480	0.0163	2/.5N
05-11C-12	0.2153	49.7500	604.5000	5.4303	1.5501	0.0163	2/.5N
05-11C-13	0.1044	49.7500	602.5000	4.7392	1.5426	0.0163	2/.5N
05-11C-14	0.2122	50.0000	596.0000	5.2067	1.5521	0.0163	2/.5N
05-11C-15	0.0732	49.7500	598.0000	4.9367	1.5492	0.0163	2/.5N
05-11C-16	0.1288	50.0000	593.5000	4.9120	1.5525	0.0163	2/.5N
05-11C-17	0.3180	50.2500	601.0000	5.4741	1.5459	0.0163	2/.5N
05-11C-18	0.0785	48.7500	800.0000	5.0379	1.3938	0.0138	2/.5N
05-11C-19	0.1501	49.2500	810.0000	5.1863	1.3915	0.0138	2/.5N
05-11C-20	0.2071	50.2500	806.5000	5.1808	1.3978	0.0138	2/.5N
05-11C-21	0.2697	50.7500	807.0000	5.3233	1.3930	0.0138	2/.5N
05-11C-22	0.0650	50.0250	804.0000	4.9095	1.3967	0.0139	2/.5N
05-11C-23	0.1110	50.7500	802.5000	4.8394	1.4045	0.0139	2/.5N
05-11C-24	0.2648	50.7500	801.5000	5.3233	1.4045	0.0139	2/.5N
05-11C-25	0.3295	49.7500	799.5000	5.7266	1.4047	0.0139	2/.5N
05-11C-26	0.2068	49.7500	804.0000	5.4303	1.3999	0.0139	2/.5N
05-11C-27	0.1414	49.2500	802.5000	5.1863	1.4041	0.0139	2/.5N
05-11C-28	0.2358	50.2500	796.0000	5.3763	1.4103	0.0139	2/.5N
05-11C-29	0.2966	50.7500	795.5000	5.5169	1.4103	0.0139	2/.5N
05-11C-30	0.0848	49.2500	793.0000	5.1863	1.4092	0.0146	2
05-11C-31	0.1435	50.7500	799.0000	4.9362	1.4059	0.0146	2
05-11C-32	0.2033	50.0000	801.5000	5.3050	1.4033	0.0146	2
05-11C-33	0.2640	50.7500	796.5000	5.3233	1.4048	0.0146	2
05-11C-34	0.1747	50.2500	797.0000	5.2786	1.4024	0.0146	2
05-11C-35	0.1132	50.7500	798.5000	4.9362	1.4045	0.0146	2
05-11C-36	0.2642	50.0000	802.0000	5.4032	1.3980	0.0061	2
05-12A-1	0.2012	49.7500	600.0000	5.4303	1.5438	0.0076	M
05-12A-2	0.2732	50.7500	597.5000	5.2266	1.5419	0.0076	M
05-12A-3	0.3515	50.7500	600.0000	5.4201	1.5434	0.0076	M
05-12A-4	0.4883	50.7500	608.0000	5.4201	1.5323	0.0076	M
05-12A-5	0.4216	51.7500	550.5000	5.3154	1.5455	0.0076	M
05-12A-6	0.3915	50.7500	592.5000	5.6137	1.5503	0.0076	M
05-12A-7	0.3526	49.2500	602.0000	5.7847	1.5416	0.0076	M
05-12A-8	0.3134	49.7500	598.0000	5.7266	1.5477	0.0076	M
05-12A-9	0.2924	50.5000	603.5000	5.3497	1.5467	0.0076	M
05-12A-10	0.2764	49.7500	582.0000	5.6278	1.5677	0.0104	M
05-12A-11	0.3108	50.0000	800.5000	5.7962	1.3918	0.0108	M
05-12A-12	0.4216	50.2500	806.0000	5.8651	1.3850	0.0108	M
05-12A-13	0.5742	50.0000	804.5000	5.8944	1.3901	0.0108	M
05-12A-14	0.3524	50.2500	800.5000	5.6696	1.3925	0.0108	M
05-12A-15	0.2496	49.5000	803.0000	5.5570	1.3883	0.0108	M
05-12A-16	0.2143	50.2500	801.5000	5.3763	1.3883	0.0108	M
05-12A-17	0.1798	50.2500	804.0000	5.1808	1.3852	0.0108	M
05-12A-18	0.1946	50.5000	805.0000	5.2524	1.3864	0.0108	M
05-12A-19	0.2138	50.7500	806.5000	5.2266	1.3859	0.0108	M
05-12A-20	0.1616	49.7500	801.0000	5.0354	1.3852	0.0108	M
05-12A-21	0.1434	49.5000	803.5000	5.0608	1.3878	0.0108	M

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
05-12B-1	0.1896	49.7500	601.0000	5.2329	1.5365	0.0108	M
05-12B-2	0.2282	49.7500	597.0000	5.1341	1.5436	0.0108	M
05-12B-3	0.2589	50.0000	602.5000	5.1085	1.5251	0.0108	M
05-12B-4	0.2948	49.2500	608.0000	5.3857	1.5338	0.0108	M
05-12B-5	0.3464	50.0000	605.5000	5.3050	1.5373	0.0108	M
05-12B-6	0.4023	50.0000	606.5000	5.3050	1.5392	0.0108	M
05-12B-7	0.2109	50.2500	796.5000	4.9853	1.3846	0.0108	M
05-12B-8	0.1425	49.7500	797.5000	4.9367	1.3833	0.0108	M
05-12B-9	0.1700	49.2500	793.0000	5.1863	1.3834	0.0108	M
05-12B-10	0.2494	49.7500	784.0000	5.3316	1.3916	0.0108	M
05-12B-11	0.2871	50.2500	789.0000	5.2786	1.3849	0.0108	M
05-12B-12	0.3361	50.7500	788.0000	5.4201	1.3877	0.0108	M
05-12B-13	0.3789	50.0000	783.5000	5.6979	1.3948	0.0108	M
05-13A-1	0.1274	50.2500	602.5000	4.3988	1.5386	0.0162	M
05-13A-2	0.1623	50.2500	601.5000	4.6921	1.5506	0.0162	M
05-13A-3	0.1603	50.2500	606.5000	4.8876	1.5392	0.0162	M
05-13A-4	0.1919	50.2500	595.0000	4.6921	1.5484	0.0162	M
05-13A-5	0.2209	49.7500	608.0000	4.8379	1.5399	0.0162	M
05-13A-6	0.2809	50.7500	605.5000	4.8394	1.5432	0.0162	M
05-13A-7	0.3136	50.7500	598.0000	4.9362	1.5539	0.0162	M
05-13A-8	0.4120	50.2500	603.5000	5.1808	1.5355	0.0095	M
05-13A-9	0.3540	50.7500	606.5000	5.1298	1.5323	0.0095	M
05-13A-10	0.3023	49.7500	613.5000	5.0354	1.5216	0.0095	M
05-13A-11	0.2833	49.7500	609.0000	5.0354	1.5323	0.0095	M
05-13A-12	0.2389	50.5000	609.5000	4.8634	1.5314	0.0095	M
05-13A-13	0.2008	50.2500	598.5000	4.6921	1.5406	0.0095	M
05-13A-14	0.1686	49.7500	602.0000	4.6405	1.5445	0.0095	M
05-13A-15	0.3504	49.7500	601.5000	5.2329	1.5393	0.0095	M
05-13A-16	0.2761	49.7500	596.0000	5.0354	1.5429	0.0095	M
05-13A-17	0.1514	49.7500	799.5000	4.6405	1.3962	0.0086	M
05-13A-18	0.2008	50.0000	801.5000	4.7155	1.3955	0.0086	M
05-13A-19	0.2203	50.2500	806.0000	4.5943	1.3887	0.0086	M
05-13A-20	0.2445	50.0000	808.0000	4.7155	1.3894	0.0086	M
05-13A-21	0.2641	50.0000	803.5000	4.8138	1.3938	0.0086	M
05-13A-22	0.2851	50.0000	801.0000	4.8138	1.3957	0.0086	M
05-13A-23	0.3068	50.0000	803.0000	4.9120	1.3965	0.0086	M
05-13A-24	0.3325	50.5000	803.0000	4.8634	1.3949	0.0086	M
05-13A-25	0.4061	50.5000	800.5000	5.0679	1.3976	0.0086	M
05-13A-26	0.3590	50.0000	801.0000	5.1085	1.3979	0.0086	M
05-13A-27	0.2225	50.0000	598.0000	4.7155	1.5594	0.0086	M
05-13A-29	0.2933	50.7500	595.0000	4.9362	1.5508	0.0086	M
05-14A-1	0.1417	50.2500	594.0000	3.2258	1.5469	0.0151	M
05-14A-2	0.1676	50.0000	606.0000	3.6349	1.5389	0.0151	M
05-14A-3	0.2018	50.7500	591.5000	3.3876	1.5509	0.0151	M
05-14A-4	0.2392	50.0000	594.5000	3.4384	1.5486	0.0151	M
05-14A-5	0.2596	50.5000	605.0000	3.4044	1.5444	0.0151	M
05-14A-6	0.2753	50.2500	607.0000	3.5190	1.5421	0.0151	M
05-14A-7	0.3102	50.2500	602.0000	3.5190	1.5443	0.0151	M
05-14A-8	0.3309	50.7500	596.0000	3.4844	1.5480	0.0151	M
05-14A-9	0.3930	50.7500	600.0000	3.5812	1.5473	0.0151	M
05-14A-10	0.1256	50.2500	812.5000	3.2258	1.3870	0.0159	M

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
05-14A-11	0.1725	50.2500	794.5000	3.4213	1.4042	0.0159	M
05-14A-12	0.2059	50.2500	799.5000	3.4213	1.3928	0.0159	M
05-14A-13	0.2517	50.7500	805.0000	3.2908	1.3918	0.0159	M
05-14A-14	0.2957	50.2500	804.5000	3.4213	1.3920	0.0159	M
05-14A-15	0.3415	50.7500	807.5000	3.3876	1.3922	0.0159	M
05-14A-16	0.3966	50.7500	809.5000	3.3876	1.3918	0.0159	M
05-15A-1	0.1361	50.2500	605.0000	3.9100	1.5429	0.0161	M
05-15A-2	0.1703	50.2500	589.0000	3.9100	1.5629	0.0161	M
05-15A-3	0.2007	50.7500	598.5000	3.8715	1.5503	0.0161	M
05-15A-4	0.2467	50.7500	604.5000	4.0651	1.5470	0.0161	M
05-15A-5	0.2875	50.7500	603.0000	4.1619	1.5440	0.0161	M
05-15A-6	0.3355	50.7500	605.0000	4.1619	1.5429	0.0161	M
05-15A-7	0.3978	50.5000	603.5000	4.1825	1.5436	0.0161	M
05-15A-8	0.3566	50.2500	601.5000	4.3988	1.5479	0.0161	M
05-15A-9	0.1232	50.0000	805.5000	3.9296	1.3918	0.0171	M
05-15A-10	0.1745	50.7500	805.0000	3.8715	1.3879	0.0171	M
05-15A-11	0.2059	50.7500	809.0000	3.8715	1.3902	0.0171	M
05-15A-12	0.2459	50.7500	811.5000	3.9683	1.3897	0.0171	M
05-15A-13	0.2922	50.2500	805.5000	4.0078	1.3928	0.0171	M
05-15A-14	0.3372	50.7500	803.5000	4.0651	1.3942	0.0171	M
05-15A-15	0.3902	51.0000	802.0000	3.9489	1.3963	0.0171	M
05-15A-16	0.3655	49.7500	803.0000	4.2455	1.3950	0.0171	M
05-16A-1	0.1464	50.0300	606.5000	5.3050	1.5532	0.0154	2
05-16A-2	0.1355	50.2500	588.5000	5.1808	1.5596	0.0154	2
05-16A-3	0.1341	50.2500	586.0000	5.1808	1.5693	0.0154	2
05-16A-4	0.1984	50.2500	596.5000	5.1808	1.5614	0.0154	2
05-16A-5	0.2269	50.2500	601.0000	5.2786	1.5546	0.0154	2
05-16A-6	0.2550	50.7500	603.0000	5.2266	1.5517	0.0154	2
05-16A-7	0.2843	50.7500	598.0000	5.4201	1.5580	0.0154	2
05-16A-8	0.3091	50.5000	599.5000	5.4470	1.5569	0.0154	2
05-16A-9	0.3106	50.2500	597.0000	5.5718	1.5580	0.0154	2
05-17A-1	0.0646	49.2500	609.5000	3.0457	1.5252	0.0087	2
05-17A-2	0.0705	49.5000	614.5000	3.4343	1.5223	0.0092	2
05-17A-3	0.1293	50.0000	612.5000	3.4000	1.5315	0.0092	2
05-17A-4	0.1939	49.4000	611.0000	3.8462	1.5340	0.0092	2
05-17A-5	0.2563	50.2000	611.0000	3.9841	1.5315	0.0092	2
05-17A-6	0.3248	50.3500	607.5000	3.9722	1.5280	0.0092	2
05-17A-7	0.2537	49.6000	608.5000	4.0323	1.5297	0.0092	2
05-17A-8	0.3193	49.9500	608.0000	4.8048	1.5268	0.0092	2
05-17A-9	0.2561	49.6500	607.5000	4.6324	1.5318	0.0092	2
05-18A-1	0.0828	48.6500	598.5000	3.6847	1.5311	0.0103	2
05-18A-2	0.0796	49.6500	598.0000	3.6254	1.5286	0.0101	2
05-18A-3	0.1396	49.4500	599.5000	4.0445	1.5254	0.0101	2
05-18A-4	0.2031	49.4000	591.5000	4.2084	1.5318	0.0101	2
05-18A-5	0.2657	49.9000	605.5000	4.4088	1.5257	0.0101	2
05-18A-6	0.3226	50.1000	588.5000	4.5908	1.5407	0.0101	2
05-18A-7	0.3531	50.6000	602.0000	4.5455	1.5351	0.0101	2
05-18A-8	0.0124	101.7500	605.5000	3.1450	2.9581	0.0101	2
05-18A-9	0.0786	99.0000	584.5000	3.5354	3.0069	0.0101	2
05-18A-10	0.1997	100.3500	591.0000	3.9860	3.0129	0.0101	2
05-19A-1	0.0	49.7500	593.5000	2.8141	1.5376	0.0087	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
05-19B-1	0.1369	50.0500	599.5000	3.1968	1.5345	0.0082	2
05-19B-2	0.2659	49.6500	601.5000	3.6108	1.5310	0.0082	2
05-19B-3	0.3561	49.8500	603.0000	3.6108	1.5273	0.0082	2
05-19B-4	0.0865	125.6000	626.0000	2.3885	3.4005	0.0061	2
05-19B-5	0.1549	125.6000	591.5000	2.5478	3.4293	0.0061	2
05-19B-6	0.1525	124.8500	610.0000	2.4830	3.3758	0.0061	2
05-19B-7	0.1395	148.8500	596.5000	2.8216	4.3814	0.0066	2
05-19B-8	0.1899	150.6000	594.5000	2.7888	4.3600	0.0066	2
05-20A-1	0.0906	50.0000	592.5000	2.6525	1.3712	0.0110	2
05-20A-2	0.1163	50.0000	609.5000	2.6525	1.3578	0.0110	2
05-20A-3	0.1489	50.6000	598.5000	2.7507	1.3640	0.0110	2
05-20A-4	0.2313	50.0000	599.0000	2.9472	1.3601	0.0110	2
05-21A-1	0.1408	50.0000	602.0000	3.5366	1.3675	0.0069	2
05-21A-2	0.1520	50.0000	605.0000	3.5366	1.3672	0.0069	2
05-21A-3	0.1202	50.0000	601.0000	3.5366	1.3710	0.0069	2
05-21A-4	0.0984	50.0000	602.0000	3.5366	1.3701	0.0069	2
05-21A-5	0.0701	50.0000	602.0000	3.5366	1.3713	0.0069	2
05-22A-1	0.2087	50.0000	591.0000	3.1437	1.5391	0.0092	2
05-22A-2	0.2701	50.0000	604.0000	3.2419	1.5316	0.0092	2
05-22A-3	0.3195	50.0000	598.0000	3.3402	1.5316	0.0092	2
05-22A-4	0.3708	50.0000	600.5000	3.3402	1.5305	0.0092	2
05-22A-5	0.1522	50.0000	602.0000	3.3402	1.5280	0.0092	2
05-23A-1	0.0	50.0000	592.0000	2.8490	1.5169	0.0096	2
05-23A-2	0.0	50.0000	591.5000	2.7507	1.5162	0.0101	2
05-23B-1	0.2168	33.5000	591.5000	4.8387	1.5362	0.0106	2
05-23B-2	0.2873	33.7500	589.0000	4.9484	1.5387	0.0106	2
05-23B-3	0.3737	33.7500	597.5000	5.2395	1.5298	0.0106	2
05-23B-4	0.1550	33.5000	602.0000	4.8387	1.5263	0.0106	2
05-23B-5	0.0991	33.5000	596.0000	4.5454	1.5295	0.0106	2
05-23B-6	0.1268	33.5000	595.5000	4.5454	1.5355	0.0106	2
05-23B-7	0.1811	33.5000	592.5000	4.8387	1.5373	0.0106	2
05-23B-8	0.0919	125.0000	575.0000	1.2800	2.6648	0.0109	2
05-23B-9	0.1510	125.0000	593.0000	1.4400	2.6753	0.0109	2
05-23B-10	0.2000	126.5000	591.0000	1.4229	2.6483	0.0109	2
05-23B-11	0.2472	124.0000	596.5000	1.4516	2.6654	0.0109	2
05-23B-12	0.2076	50.0000	585.0000	3.4000	1.5311	0.0104	2/.5N
05-23B-13	0.1574	50.0000	597.5000	3.4000	1.5409	0.0104	2/.5N
05-23B-14	0.1018	50.0000	593.5000	3.1809	1.5438	0.0104	2/.5N
05-23B-15	0.4321	49.0000	601.5000	3.6735	1.5330	0.0104	2/.5N
05-23B-16	0.3039	50.5000	595.0000	3.3663	1.5419	0.0104	2/.5N
05-23B-17	0.2632	50.0000	594.5000	3.4000	1.5419	0.0104	2/.5N
05-23B-18	0.3460	50.0000	594.5000	3.6000	1.5391	0.0104	2/.5N
05-23B-19	0.3878	50.0000	601.5000	3.8000	1.5351	0.0104	2/.5N
05-23B-20	0.2173	50.0000	596.0000	3.4000	1.5320	0.0112	2
05-23B-21	0.1222	198.5000	590.5000	0.6045	2.9238	0.0112	2
05-23B-22	0.1674	197.0000	616.0000	0.6599	2.7066	0.0112	2
05-24A-1	0.0	50.0000	598.5000	2.8000	1.3279	0.0103	2
05-24B-1	0.1245	50.0000	596.0000	3.6000	1.3482	0.0099	2
05-24B-2	0.1525	50.0000	596.0000	3.8000	1.3525	0.0099	2
05-25A-1	0.1310	50.0000	597.5000	4.0000	1.3558	0.0123	2
05-25A-2	0.1669	50.0000	596.5000	4.2000	1.3621	0.0123	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	ECR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
05-25A-3	0.4052	50.0000	595.5000	5.0000	1.3575	0.0123	2
05-25A-4	0.3518	50.0000	595.0000	4.6000	1.3596	0.0123	2
05-25A-5	0.3066	50.0000	599.5000	4.6000	1.3565	0.0123	2
05-25A-6	0.2585	50.0000	598.5000	4.4000	1.3572	0.0123	2
05-25A-7	0.2143	50.0000	598.5000	4.4000	1.3569	0.0123	2
05-25A-8	0.1676	50.0000	598.0000	4.2000	1.3556	0.0123	2
05-25A-9	0.1298	50.0000	600.0000	4.0000	1.3575	0.0123	2
05-25A-10	0.4058	50.0000	601.5000	5.0000	1.3459	0.0123	2
05-26A-1	0.1553	49.0000	604.0000	3.8775	1.5882	0.0173	2
05-26A-2	0.2068	50.0000	600.0000	3.8000	1.5942	0.0173	2
05-26A-3	0.2617	49.7500	606.0000	3.8191	1.5852	0.0173	2
06-01A-1	0.1756	50.2500	610.5000	1.9550	1.5365	0.0094	M
06-01A-2	0.2478	50.7500	604.5000	1.9358	1.5448	0.0094	M
06-01A-3	0.3071	50.2500	607.5000	2.0528	1.5405	0.0094	M
06-02A-1	0.1756	50.2500	608.0000	1.8573	1.5273	0.0073	M
06-02A-2	0.2911	50.2500	613.5000	2.0528	1.5231	0.0073	M
06-03A-1	0.1724	50.5000	610.5000	1.9453	1.5269	0.0069	M
06-03A-2	0.2559	50.2500	603.0000	1.9550	1.5340	0.0069	M
06-03A-3	0.0860	47.7500	662.5000	2.0574	1.5318	0.0069	M
06-03A-4	0.1183	49.2500	668.5000	1.9947	1.5389	0.0069	M	+2
06-04A-1	0.0659	49.0000	632.5000	5.1125	2.3052	0.0124	M
06-05A-1	0.0844	49.7500	638.0000	3.7519	1.5361	0.0021	M
06-05A-2	0.1190	50.0000	643.5000	3.7331	1.5294	0.0021	M
06-05A-3	0.1611	50.2500	622.0000	3.7145	1.5318	0.0021	M
06-05A-4	0.2251	50.5000	616.5000	3.7934	1.5315	0.0021	M
06-05A-5	0.2786	50.2500	622.0000	4.0078	1.5308	0.0021	M
06-05A-6	0.0539	50.0000	652.0000	2.7507	1.5315	0.0039	M	+2
06-05A-7	0.0659	50.2500	649.0000	2.7370	1.5336	0.0039	M	+2
06-05A-8	0.0783	50.0000	654.0000	2.7507	1.5320	0.0039	M	+2
06-05A-9	0.0914	50.2500	652.0000	2.8348	1.5315	0.0039	M	+2
06-05A-10	0.1278	50.5000	643.0000	2.8208	1.5334	0.0039	M	+2
06-05A-11	0.1393	50.7500	644.0000	2.8069	1.5379	0.0039	M	+2
06-05A-12	0.1521	50.2500	643.5000	2.8348	1.5376	0.0039	M	+2
06-05A-13	0.1623	50.7500	643.5000	2.9036	1.5372	0.0039	M	+2
06-05A-14	0.1911	50.2500	643.0000	3.1280	1.5350	0.0039	M	+2
06-05A-15	0.1101	49.2500	638.0000	2.7926	1.5351	0.0039	M	+2
06-05A-16	0.1189	49.7500	605.5000	2.6658	1.5605	0.0036	M	+2
06-05A-17	0.1567	50.0000	636.0000	2.7507	1.5334	0.0036	M	+2
06-05A-18	0.1880	49.2500	639.0000	2.7926	1.5326	0.0036	M	+2
06-05A-19	0.2052	49.7500	639.5000	2.7645	1.5315	0.0036	M	+2
06-05A-20	0.2192	49.7500	635.5000	2.7645	1.5323	0.0036	M	+2
06-05A-21	0.2337	49.7500	640.0000	2.7645	1.5281	0.0036	M	+2
06-05A-22	0.1248	49.2500	636.5000	2.5931	1.5355	0.0036	M	+2
06-05A-23	0.0766	50.2500	643.0000	2.3460	1.5348	0.0038	M	+2
06-05A-24	0.0895	49.7500	648.0000	5.2329	2.1947	0.0038	M	+2
06-05A-25	0.1502	50.0000	649.5000	5.6979	2.1916	0.0038	M	+2
06-05A-26	0.1331	49.7500	657.5000	5.7266	2.1845	0.0038	M	+2
06-05A-27	0.1247	49.7500	656.5000	5.7266	2.1860	0.0038	M	+2
06-05A-28	0.1151	49.7500	649.5000	5.7266	2.2173	0.0038	M	+2
06-05A-29	0.0612	50.5000	621.0000	5.2524	2.2076	0.0034	M	+2
06-05A-30	0.0475	50.0000	626.0000	5.4032	2.2040	0.0034	M	+2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
07-01A-1	0.0	50.0000	603.5000	3.0000	1.2466	0.0170	2
07-02A-1	0.2074	50.0000	603.5000	5.8000	1.0977	0.0160	2
07-02A-2	0.2251	50.0000	606.0000	6.0000	1.0735	0.0160	2
07-02A-3	0.2718	50.0000	604.0000	7.0000	1.0837	0.0160	2
07-02A-4	0.2529	50.0000	598.5000	6.8000	1.0701	0.0160	2
07-02A-5	0.2210	50.0000	602.5000	5.8000	1.0726	0.0160	2
07-02B-1	0.2071	50.0000	598.5000	6.6000	1.0413	0.0147	2
07-02B-2	0.1744	50.0000	599.5000	6.6000	1.0676	0.0147	2
07-02B-3	0.1661	50.0000	599.5000	6.2000	1.0697	0.0147	2
07-02B-4	0.2688	50.0000	599.5000	7.0000	1.0580	0.0147	2
07-02B-5	0.2668	50.0000	601.0000	7.0000	1.0495	0.0147	2
07-02B-6	0.2369	50.0000	604.0000	6.6000	1.0580	0.0147	2
07-02B-7	0.3272	50.0000	601.5000	6.6000	1.0519	0.0147	2
07-02B-8	0.2983	50.0000	599.0000	6.6000	1.0553	0.0147	2
07-02B-9	0.2044	50.0000	599.5000	6.4000	1.0541	0.0147	2
07-03A-1	0.2357	50.0000	601.5000	6.2000	1.0926	0.0113	2
07-03A-2	0.2140	50.0000	600.5000	6.4000	1.1026	0.0113	2
07-03A-3	0.2419	50.0000	600.0000	5.8000	1.0642	0.0120	2
07-03A-4	0.2237	50.0000	599.0000	5.8000	1.0549	0.0120	2
07-03A-5	0.2000	50.0000	604.5000	6.2000	1.0723	0.0120	2
07-03A-6	0.1789	50.0000	603.5000	5.8000	1.0793	0.0120	2
07-03A-7	0.1920	50.0000	603.5000	6.0000	1.0726	0.0120	2
07-03A-8	0.2353	50.0000	604.0000	6.4000	1.0574	0.0103	2
07-03A-9	0.2166	50.0000	598.0000	6.2000	1.0427	0.0103	2
07-03A-10	0.2012	50.0000	603.0000	6.2000	1.0687	0.0103	2
07-03A-11	0.2319	50.0000	603.5000	6.6000	1.0724	0.0103	2
07-03A-12	0.2002	50.0000	598.0000	6.4000	1.0748	0.0103	2
07-03A-13	0.2013	50.0000	604.0000	6.2000	1.0681	0.0103	2
07-03A-14	0.2854	50.0000	605.0000	5.8000	1.0694	0.0103	2
07-03A-15	0.2812	50.0000	603.0000	6.0000	1.0701	0.0103	2
07-03A-16	0.3065	50.0000	599.5000	7.0000	1.0633	0.0103	2
07-03A-17	0.3161	50.0000	600.0000	7.0000	1.0831	0.0103	2
07-04A-1	0.2125	50.0000	606.0000	3.6000	1.0720	0.0110	2
07-05A-1	0.2529	50.0000	602.0000	6.2000	1.0671	0.0127	2
07-05A-2	0.2291	50.0000	604.0000	6.0000	1.0864	0.0127	2
07-05A-3	0.2237	50.0000	600.5000	5.8000	1.0753	0.0127	2
07-05A-4	0.2165	50.0000	602.5000	5.6000	1.0719	0.0127	2
07-06A-1	0.2573	50.0000	606.5000	5.8000	1.0486	0.0159	2
07-06A-2	0.2370	50.0000	598.5000	6.2000	1.0491	0.0159	2
07-06A-3	0.2154	50.0000	604.5000	6.2000	1.0565	0.0159	2
07-06A-4	0.2096	50.0000	602.0000	6.0000	1.0453	0.0159	2
07-06A-5	0.2049	50.0000	601.5000	6.0000	1.0492	0.0159	2
07-06A-6	0.1966	50.0000	604.5000	6.0000	1.0514	0.0159	2
07-06A-7	0.1890	50.0000	604.0000	6.0000	1.0490	0.0159	2
07-06A-8	0.1771	50.0000	603.0000	6.2000	1.0476	0.0159	2
07-06A-9	0.2625	50.0000	605.0000	6.2000	1.0262	0.0150	2
07-06A-10	0.2420	50.0000	603.5000	6.0000	1.0268	0.0150	2
07-06A-11	0.2219	50.0000	602.0000	6.0000	1.0249	0.0150	2
07-06A-12	0.2009	50.0000	602.5000	5.8000	1.0276	0.0150	2
07-06A-13	0.1883	50.0000	601.0000	5.6000	1.0299	0.0150	2
07-07A-1	0.2460	50.0000	601.5000	6.8000	1.0909	0.0129	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
07-07A-2	0.2261	50.0000	610.0000	7.0000	1.0953	0.0129	2
07-07A-3	0.2058	50.0000	605.5000	7.0000	1.1117	0.0129	2
07-07A-4	0.1857	50.0000	600.5000	7.2000	1.1081	0.0129	2
07-07A-5	0.2699	50.0000	603.5000	6.4000	0.9998	0.0151	2
07-07A-6	0.2469	50.0000	602.0000	6.4000	1.0082	0.0151	2
07-07A-7	0.2232	50.0000	605.5000	6.6000	1.0204	0.0151	2
07-07A-8	0.1991	50.0000	594.0000	6.4000	1.0373	0.0151	2
07-07A-9	0.1997	99.0000	602.5000	3.5354	1.6638	0.0151	2
07-07A-10	0.1876	99.5000	597.5000	3.6181	1.6595	0.0151	2
07-07A-11	0.1743	99.5000	600.5000	3.7186	1.6674	0.0151	2
07-07A-12	0.1668	101.0000	600.0000	3.6634	1.6666	0.0151	2
07-07A-13	0.1603	100.0000	601.5000	3.7000	1.6809	0.0151	2
07-07A-14	0.1565	100.0000	601.5000	3.3000	1.6691	0.0151	2
07-07A-15	0.2540	50.0000	599.0000	4.2000	0.8140	0.0151	2
07-07A-16	0.2277	50.0000	600.5000	4.4000	0.8157	0.0151	2
07-07A-17	0.2113	50.0000	605.0000	4.4000	0.8183	0.0151	2
07-07A-18	0.2049	50.0000	600.5000	4.2000	0.8018	0.0151	2
07-07A-19	0.1909	50.0000	598.5000	4.2000	0.8151	0.0151	2
07-07A-20	0.1748	50.0000	602.0000	4.2000	0.8154	0.0151	2
07-07A-21	0.1646	140.0000	599.0000	4.1429	2.6460	0.0151	2
07-07A-22	0.1811	141.5000	607.0000	4.0283	2.6340	0.0151	2
07-07A-23	0.1731	141.5000	597.5000	4.0283	2.6339	0.0151	2
07-07A-24	0.1661	142.0000	601.5000	4.0845	2.6222	0.0151	2
07-07A-25	0.1580	142.0000	594.5000	3.9437	2.6297	0.0151	2
07-07A-26	0.1516	144.0000	596.0000	3.8194	2.6056	0.0151	2
07-07A-27	0.2980	50.0000	807.0000	5.8000	0.9016	0.0163	2
07-07A-28	0.2833	49.7500	806.5000	5.8291	0.8744	0.0163	2
07-07A-29	0.2588	49.0000	804.5000	5.9184	0.8761	0.0163	2
07-07A-30	0.2372	50.0000	800.0000	5.6000	0.8675	0.0163	2
07-07A-31	0.2134	50.0000	798.0000	5.6000	0.8667	0.0163	2
07-07A-32	0.2046	50.0000	805.0000	5.4000	0.8626	0.0163	2
07-07A-33	0.1934	49.5000	810.0000	5.4545	0.8685	0.0163	2
07-07A-34	0.1832	50.0000	803.0000	5.2000	0.8695	0.0163	2
07-07A-35	0.1727	50.0000	798.5000	5.2000	0.8711	0.0163	2
07-07A-36	0.1650	50.0000	802.0000	5.2000	0.8442	0.0163	2
07-07A-37	0.1586	49.5000	804.5000	5.2525	0.8380	0.0163	2
07-07A-38	0.1459	49.0000	805.0000	5.1020	0.8219	0.0163	2
07-07A-39	0.1779	99.5000	804.0000	3.7186	1.5095	0.0163	2
07-07A-40	0.1649	100.2500	803.5000	3.5910	1.4995	0.0163	2
07-07A-41	0.1523	99.2500	803.5000	3.6272	1.4867	0.0163	2
07-07A-42	0.1473	99.0000	803.0000	3.6364	1.4797	0.0163	2
07-07A-43	0.1424	98.2500	800.0000	3.6641	1.4714	0.0163	2
07-07A-44	0.2344	49.0000	812.0000	5.8775	0.6965	0.0163	2
07-07A-45	0.2125	50.0000	799.0000	3.6000	0.6671	0.0163	2
07-07A-46	0.1964	49.7500	803.5000	3.6181	0.6547	0.0163	2
07-07A-47	0.1334	48.0000	805.5000	3.5417	0.6632	0.0163	2
11-01A-1	0.2828	49.6000	597.0000	4.6545	1.3469	0.0020	2
11-01A-2	0.3855	49.8500	597.0000	4.9268	1.3459	0.0020	2
11-01A-3	0.2497	49.5000	794.0000	2.5800	1.1128	0.0038	2
11-02A-1	0.0	50.5000	592.0000	2.9180	1.0757	0.0029	2
11-03A-1	0.0067	49.6000	609.0000	7.6255	1.1957	0.0067	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
11-04A-1	0.0187	48.8500	610.0000	5.0276	0.9885	0.0040	A
11-05A-1	0.2132	50.0000	600.0000	4.9120	0.9885	0.0117	2
11-06A-1	0.0	49.7500	608.5000	4.9367	0.7926	0.0156	2
11-06A-2	0.3372	61.5000	616.0000	1.9967	0.8036	0.0156	2
11-07A-1	0.0	49.2500	81.0000	4.8871	2.1710	0.0093	G
11-07A-2	0.0	45.0000	594.5000	5.6761	1.4319	0.0099	G
11-08A-1	0.1387	50.2500	597.0000	3.7145	1.4063	0.0136	G
11-08A-2	0.1912	49.5000	592.5000	3.6716	1.4386	0.0136	G
11-08A-3	0.2497	49.7500	603.5000	3.8506	1.4217	0.0136	G
11-08A-4	0.3086	49.7500	602.0000	3.9493	1.4190	0.0136	G
11-09A-1	0.0	50.0000	601.5000	2.9472	1.9526	0.0151	G
11-09A-2	0.0	50.0000	602.5000	1.9646	1.6892	0.0157	G
11-10A-1	0.1578	55.0000	608.5000	2.0541	1.3803	0.0147	G
11-10A-2	0.1235	55.2500	599.5000	2.0448	1.3858	0.0147	G
11-10A-3	0.0926	56.5000	599.5000	1.9996	1.3845	0.0147	G
11-11A-1	0.0262	49.0000	606.0000	3.4083	1.0625	0.0142	2
11-12A-1	0.3461	50.0000	608.5000	2.9472	1.2712	0.0088	2
11-12A-2	0.3246	49.0000	605.0000	3.0073	1.2595	0.0088	2
11-12A-3	0.2969	50.5000	603.5000	2.8208	1.2621	0.0088	2
14-01A-1	0.1359	14.7000	119.5000	0.6683	0.3328	0.0094	M
14-01A-2	0.1428	14.7000	501.5000	0.6683	0.3156	0.0094	M
14-01A-3	0.1326	50.2500	607.0000	2.6393	1.6990	0.0094	M
14-02A-1	0.3550	64.5000	612.5000	1.9039	1.6666	0.0094	M
14-02A-2	0.2251	50.5000	606.5000	2.9180	1.8747	0.0117	M
14-02A-3	0.2805	50.7500	611.5000	3.0004	1.8706	0.0117	M
14-02A-4	0.3187	50.0000	617.0000	3.1437	1.8640	0.0117	M
14-02A-5	0.3735	50.7500	599.0000	3.1940	1.8837	0.0117	M
14-02A-6	0.3059	50.0000	605.0000	2.8490	1.7582	0.0117	M
14-02A-7	0.2354	50.0000	605.0000	2.7507	1.7065	0.0117	M
14-02A-8	0.3447	49.7500	602.0000	2.9620	1.7085	0.0117	M
16-01A-1	0.2684	49.0000	600.0000	3.9095	1.0559	0.0188	2
16-01A-2	0.2486	50.0000	595.5000	3.8314	1.0373	0.0188	2
16-01A-3	0.2601	49.7500	600.0000	3.8506	1.0407	0.0188	2
16-01B-1	0.2483	48.7500	608.0000	4.2319	1.0697	0.0185	2
16-02A-1	0.2563	49.7500	604.5000	3.8506	1.0871	0.0172	2
16-02A-2	0.2360	48.7500	600.0000	3.9296	1.0898	0.0172	2
16-02A-3	0.2183	49.7500	606.0000	3.6531	1.0809	0.0172	2
16-03A-1	0.2629	49.7500	604.5000	4.4430	1.0572	0.0158	2
16-03A-2	0.2420	49.2500	598.5000	4.4881	1.0606	0.0158	2
16-03A-3	0.2171	49.7500	806.0000	5.4303	0.9873	0.0158	2
18-01A-1	0.1493	50.0000	600.5000	3.4000	1.2754	0.0123	2
18-01A-2	0.2114	50.0000	605.0000	3.4000	1.2784	0.0123	2
18-01A-3	0.2779	49.5000	596.0000	3.4343	1.2747	0.0123	2
18-01A-4	0.3431	50.5000	600.5000	3.3663	1.2773	0.0123	2
18-01A-5	0.3767	50.0000	601.0000	3.4000	1.2733	0.0123	2
18-01A-6	0.1493	49.0000	603.0000	3.2653	1.2733	0.0123	2
18-01A-7	0.2086	50.0000	601.0000	3.4000	1.2744	0.0123	2
18-01A-8	0.3744	50.0000	604.0000	3.6000	1.2813	0.0123	2
18-01A-9	0.2492	50.0000	601.0000	1.2000	0.7624	0.0123	2
18-01A-10	0.3452	50.0000	603.0000	1.2000	0.7203	0.0123	2
18-01A-11	0.3858	50.0000	605.5000	1.2000	0.7207	0.0123	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
26-01A-1	0.0	50.0000	599.0000	3.8314	0.6115	0.0113	2
26-02A-1	0.3700	50.0000	600.5000	6.4838	0.5416	0.0117	2
26-02A-2	0.3914	50.0000	599.0000	6.6803	0.5639	0.0117	2
26-02A-3	0.4466	50.0000	602.0000	6.6803	0.5398	0.0117	2
26-02A-4	0.4658	50.0000	601.0000	7.2698	0.5613	0.0117	2
26-02A-5	0.4987	50.0000	603.0000	7.5645	0.5650	0.0117	2
26-02A-6	0.4711	49.5000	601.0000	6.3509	0.5038	0.0117	2/.5N
26-02A-7	0.4193	50.0000	604.5000	6.4838	0.5159	0.0117	2/.5N
26-02A-8	0.3634	50.0000	603.5000	6.4838	0.5370	0.0117	2/.5N
26-02A-9	0.4511	50.0000	887.0000	6.2874	0.3989	0.0117	2
26-02A-10	0.3921	49.5000	892.0000	5.5570	0.4061	0.0117	2
26-03A-1	0.3684	50.0000	608.0000	7.4662	0.5643	0.0108	P
26-03A-2	0.2905	49.0000	609.5000	4.6113	0.6000	0.0108	P
26-03A-3	0.3382	50.0000	606.0000	4.7155	0.5899	0.0108	P
26-03A-4	0.3640	49.5000	608.5000	5.2593	0.6059	0.0108	P
26-03A-5	0.2700	50.0000	606.0000	4.1261	0.5841	0.0108	P
26-03A-6	0.3677	44.7500	602.5000	5.0492	0.4364	0.0053	2
26-03A-7	0.3351	45.7500	599.5000	6.2272	0.4146	0.0053	2
26-03A-8	0.2692	45.7500	610.5000	4.0799	0.4365	0.0053	2
26-03A-9	0.2864	45.7500	612.5000	2.1473	0.3189	0.0053	2
26-03A-10	0.4004	45.2500	586.5000	1.3026	0.2353	0.0053	P
28-01A-1	0.1385	50.0000	603.0000	4.0000	1.3456	0.0145	2
28-01A-2	0.2315	50.0000	599.5000	4.6000	1.3488	0.0145	2
28-01A-3	0.2776	50.0000	598.5000	4.6000	1.3517	0.0145	2
28-01A-4	0.3254	50.0000	600.0000	4.8000	1.3475	0.0145	2
28-01A-5	0.3726	50.0000	601.0000	4.8000	1.3444	0.0145	2
28-01A-6	0.4000	50.0000	598.0000	5.0000	1.3549	0.0145	2
28-01A-7	0.4347	50.0000	604.0000	5.0000	1.3409	0.0145	2
28-02A-1	0.1698	49.8500	603.0000	5.0150	1.2251	0.0157	2
28-02A-2	0.2151	49.8500	602.0000	5.6169	1.2407	0.0157	2
28-02A-3	0.2689	49.8500	599.5000	5.6169	1.2407	0.0157	2
28-02A-4	0.3225	49.8500	601.0000	5.8175	1.2306	0.0157	2
28-02A-5	0.3773	49.8500	603.5000	5.6169	1.2263	0.0157	2
28-02A-6	0.4238	49.8500	602.0000	5.6169	1.2376	0.0157	2
28-03A-1	0.1773	50.0000	602.0000	5.6000	1.3852	0.0172	2
28-03A-2	0.2377	49.7500	597.0000	6.0302	1.3865	0.0172	2
28-03A-3	0.2982	49.7500	594.5000	6.2312	1.3832	0.0172	2
28-03A-4	0.3593	50.0000	601.0000	6.2000	1.3819	0.0172	2
28-03A-5	0.4203	50.0000	599.5000	6.4000	1.3799	0.0172	2
28-04A-6	0.0	49.0000	601.0000	4.0816	1.3679	0.0165	M
28-05A-1	0.1649	49.5000	604.0000	4.4444	1.3612	0.0152	M
28-05A-2	0.2177	48.7500	598.5000	4.9231	1.3797	0.0152	M
28-05A-3	0.2766	49.5000	602.5000	5.0505	1.3655	0.0152	M
28-05A-4	0.3334	50.2500	596.0000	4.9751	1.3755	0.0152	M
28-05A-5	0.3978	49.7500	599.5000	5.2261	1.3745	0.0152	M
28-05A-6	0.1566	49.0000	604.5000	4.4898	1.3539	0.0176	M
28-05A-7	0.1998	49.2500	602.0000	4.8731	1.3761	0.0176	M
28-05A-8	0.2573	49.7500	602.0000	5.0251	1.3764	0.0176	M
28-05A-9	0.3159	49.7500	604.0000	5.0251	1.3751	0.0176	M
28-05A-10	0.3734	49.7500	602.0000	5.2261	1.3775	0.0176	M
28-05A-11	0.4327	49.5000	603.0000	5.4545	1.3740	0.0176	M

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
28-05A-12	0.4619	50.0000	603.0000	5.4000	1.3756	0.0176	M
28-05A-13	0.4915	50.0000	606.5000	5.4000	1.3761	0.0176	M
28-05A-14	0.2002	49.7500	595.0000	4.6231	1.3733	0.0176	M
28-06A-1	0.1523	50.2500	597.5000	3.9801	1.3651	0.0146	M
28-06A-2	0.1927	50.2500	605.0000	3.9801	1.3710	0.0146	M
28-06A-3	0.2480	50.2500	599.5000	4.1791	1.3721	0.0146	M
28-06A-4	0.3039	49.2500	603.5000	4.4670	1.3709	0.0146	M
28-06A-5	0.3579	48.7500	604.5000	4.5128	1.3782	0.0146	M
28-06A-6	0.4131	49.2500	596.5000	4.4670	1.3876	0.0146	M
28-06A-7	0.4484	49.2500	602.0000	4.4670	1.3636	0.0146	M
28-06A-8	0.3065	49.2500	604.5000	4.2640	1.3666	0.0146	M
28-07A-1	0.1518	50.2500	607.5000	5.3731	1.3768	0.0170	M
28-07A-2	0.1965	50.0000	599.0000	5.6000	1.3738	0.0170	M
28-07A-3	0.2524	50.0000	599.0000	5.8000	1.3774	0.0170	M
28-07A-4	0.3091	50.2500	605.0000	5.7711	1.3772	0.0170	M
28-07A-5	0.3655	49.7500	603.0000	6.2312	1.3788	0.0170	M
28-07A-6	0.4214	50.0000	599.5000	6.2000	1.3801	0.0170	M
28-07A-7	0.4465	50.0000	595.0000	6.2000	1.3893	0.0170	M
28-07A-8	0.4347	49.5000	597.5000	6.2626	1.3824	0.0170	M
28-07A-9	0.1980	50.0000	602.0000	5.6000	1.3777	0.0170	M
29-01A-1	0.3242	49.2500	603.5000	5.1863	1.1292	0.0165	2
29-01A-2	0.4038	50.2500	603.5000	5.1808	1.1258	0.0165	2
29-01A-3	0.2448	49.2500	598.5000	4.9868	1.1358	0.0165	2
29-01A-4	0.1832	49.2500	600.0000	4.9868	1.1705	0.0165	2
29-02A-1	0.2490	50.2500	596.5000	4.6921	1.1185	0.0167	2
29-02A-2	0.1879	49.7500	600.0000	4.9367	1.1429	0.0167	2
29-02A-3	0.1482	50.2500	598.5000	4.4966	1.1375	0.0167	2
29-02A-4	0.1055	49.5000	601.0000	4.5647	1.1441	0.0167	2
29-02A-5	0.0779	50.2500	601.5000	4.3011	1.1363	0.0167	2
29-02A-6	0.3040	50.0000	602.5000	5.0102	1.1310	0.0167	2
29-02A-7	0.3616	49.7500	600.0000	5.1341	1.1361	0.0167	2
29-02A-8	0.2491	49.7500	604.0000	4.6405	1.1234	0.0103	2/.5N
29-02A-9	0.3081	50.2500	598.5000	4.6921	1.1227	0.0103	2/.5N
29-02A-10	0.1893	49.7500	603.0000	4.8379	1.1406	0.0103	2/.5N
29-02A-11	0.1266	49.2500	603.5000	4.6876	1.1445	0.0103	2/.5N
29-02A-12	0.0778	49.7500	600.5000	4.3443	1.1446	0.0103	2/.5N
29-02A-13	0.0544	49.2500	602.5000	4.3884	1.1419	0.0103	2/.5N
29-02A-14	0.1303	50.2500	603.5000	4.2033	1.1087	0.0103	2/.5N
29-03A-1	0.2104	50.2500	601.0000	4.6921	1.1181	0.0152	2
29-03A-2	0.2686	50.2500	603.5000	4.7898	1.1165	0.0152	2
29-03A-3	0.3079	50.2500	602.0000	4.8876	1.1165	0.0152	2
29-03A-4	0.3465	50.2500	603.0000	4.9853	1.1203	0.0152	2
29-03A-5	0.0855	49.7500	598.0000	4.3443	1.1415	0.0152	2
29-03A-6	0.1270	49.7500	597.5000	4.3443	1.1328	0.0152	2
29-03A-7	0.1712	50.2500	600.0000	4.4966	1.1294	0.0152	2
29-03A-8	0.0538	49.7500	601.0000	4.2455	1.1476	0.0152	2
29-03A-9	0.1895	50.0000	595.0000	4.4208	1.1308	0.0152	2
29-03A-10	0.1913	50.2500	602.0000	4.8876	1.1317	0.0168	2/.5N
29-03A-11	0.2286	50.0000	606.0000	5.1085	1.1328	0.0168	2/.5N
29-03A-12	0.2656	49.7500	602.5000	5.2329	1.1382	0.0168	2/.5N
29-03A-13	0.3057	49.7500	604.5000	5.2329	1.1341	0.0168	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-03A-14	0.3474	49.7500	603.5000	5.3316	1.1271	0.0168	2/.5N
29-03A-15	0.1397	49.7500	601.0000	4.5417	1.1428	0.0168	2/.5N
29-03A-16	0.1067	50.0000	604.5000	4.4208	1.1379	0.0168	2/.5N
29-03A-17	0.0790	49.2500	607.0000	4.3884	1.1286	0.0168	2/.5N
29-03A-18	0.0551	49.7500	605.5000	4.3443	1.1290	0.0168	2/.5N
29-04A-1	0.0911	50.0000	605.0000	3.8314	1.1318	0.0172	2
29-04A-2	0.1265	50.0000	603.5000	3.9296	1.1320	0.0172	2
29-04A-3	0.1635	50.0000	599.0000	4.1261	1.1407	0.0172	2
29-04A-4	0.1269	50.0000	591.5000	3.8314	1.1369	0.0167	2
29-04A-5	0.1729	50.0000	598.5000	3.9296	1.1215	0.0167	2
29-04A-6	0.2098	50.0000	602.0000	4.1261	1.1245	0.0167	2
29-04A-7	0.2475	49.5000	602.5000	4.2670	1.1252	0.0167	2
29-04A-8	0.2873	50.0000	603.0000	4.3226	1.1210	0.0167	2
29-04A-9	0.3220	49.5000	600.0000	4.5647	1.1374	0.0167	2
29-05A-1	0.0868	49.5000	604.0000	3.7708	1.1275	0.0174	2
29-05A-2	0.1289	50.0000	604.0000	3.7331	1.1192	0.0174	2
29-05A-3	0.1735	50.0000	600.0000	3.9296	1.1187	0.0174	2
29-05A-4	0.2108	50.0000	599.0000	4.0278	1.1201	0.0174	2
29-05A-5	0.2463	50.0000	598.5000	4.3226	1.1227	0.0174	2
29-05A-6	0.2861	49.5000	601.0000	4.4655	1.1264	0.0174	2
29-05A-7	0.3244	49.5000	602.0000	4.5647	1.1314	0.0174	2
29-05A-8	0.3647	50.0000	602.0000	4.7155	1.1267	0.0174	2
29-05A-9	0.2258	50.0000	596.0000	4.4208	1.1367	0.0174	2
29-06A-1	0.1265	49.5000	595.0000	4.0685	1.1368	0.0160	2
29-06A-2	0.1706	50.0000	598.5000	4.2243	1.1331	0.0160	2
29-06A-3	0.2076	50.0000	600.5000	4.4208	1.1339	0.0160	2
29-06A-4	0.2442	50.0000	597.5000	4.5190	1.1382	0.0160	2
29-06A-5	0.2825	49.5000	599.5000	4.7632	1.1384	0.0160	2
29-06A-6	0.3216	49.5000	599.5000	4.7632	1.1374	0.0160	2
29-06A-7	0.1297	50.0000	597.5000	4.2243	1.1178	0.0172	2/.5N
29-06A-8	0.1749	50.2500	600.0000	4.3011	1.1146	0.0172	2/.5N
29-06A-9	0.2123	50.0000	599.5000	4.4208	1.1168	0.0172	2/.5N
29-06A-10	0.2497	50.0000	600.0000	4.6173	1.1216	0.0172	2/.5N
29-06A-11	0.2889	49.7500	603.0000	4.8379	1.1221	0.0172	2/.5N
29-06A-12	0.3261	49.7500	599.0000	4.9367	1.1305	0.0172	2/.5N
29-06A-13	0.3663	50.0000	596.0000	5.0102	1.1287	0.0172	2/.5N
29-06A-14	0.2285	50.0000	594.5000	4.6173	1.1304	0.0172	2/.5N
29-06A-15	0.1917	50.0000	599.5000	4.4208	1.1258	0.0172	2/.5N
29-06A-16	0.2388	49.5000	599.0000	4.6639	1.1261	0.0172	2/.5N
29-06A-17	0.1071	49.5000	597.5000	4.2670	1.1314	0.0172	2/.5N
29-06A-18	0.2473	49.7500	593.0000	4.5417	1.1300	0.0172	2/.5N
29-07A-1	0.1767	50.0000	604.0000	3.4384	1.1063	0.0194	2/.5N
29-07A-2	0.2144	50.0000	601.5000	3.6349	1.1091	0.0194	2/.5N
29-07A-3	0.2484	50.0000	601.5000	4.0278	1.1303	0.0194	2/.5N
29-07A-4	0.2902	50.0000	599.0000	4.0278	1.1191	0.0194	2/.5N
29-07A-5	0.3488	50.0000	595.0000	4.1261	1.1231	0.0194	2/.5N
29-08A-1	0.1729	50.0000	610.5000	4.5190	1.1292	0.0150	2/.5N
29-08A-2	0.2096	49.5000	604.0000	4.7632	1.1335	0.0150	2/.5N
29-08A-3	0.2484	49.0000	606.5000	5.2127	1.1298	0.0150	2/.5N
29-08A-4	0.2862	49.5000	605.5000	5.0608	1.1351	0.0150	2/.5N
29-08A-5	0.3297	49.0000	610.5000	5.2127	1.1210	0.0150	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-08A-6	0.2290	48.7500	602.0000	4.9372	1.1317	0.0150	27.5N
29-08A-7	0.1270	49.5000	596.5000	4.5647	1.1451	0.0150	27.5N
29-08A-8	0.0869	50.0000	594.0000	4.2243	1.1340	0.0150	27.5N
29-09A-1	0.1715	49.5000	607.0000	4.4655	1.0826	0.0167	2
29-09A-2	0.2105	50.5000	609.0000	4.1825	1.0817	0.0167	2
29-09A-3	0.2489	50.0000	609.0000	4.3226	1.0816	0.0167	2
29-09A-4	0.2877	49.5000	610.0000	4.4655	1.0829	0.0167	2
29-09A-5	0.3270	50.7500	608.5000	4.2587	1.0808	0.0167	2
29-09A-6	0.1704	50.0000	614.0000	3.9296	1.0903	0.0167	2
29-09A-7	0.1988	50.0000	620.5000	4.2243	1.1452	0.0167	2
29-09A-8	0.2553	50.0000	624.5000	4.5190	1.0559	0.0167	2
29-09A-9	0.2795	50.0000	617.0000	4.6173	1.1142	0.0167	2
29-09A-10	0.3172	49.5000	622.5000	4.6639	1.1145	0.0167	2
29-09A-11	0.3550	50.0000	615.5000	4.7155	1.1139	0.0167	2
29-09A-12	0.2520	49.5000	621.0000	4.5647	1.1157	0.0175	27.5N
29-09A-13	0.2912	50.0000	618.5000	4.6173	1.1163	0.0175	27.5N
29-09A-14	0.3321	49.0000	618.0000	4.7115	1.1140	0.0175	27.5N
29-09A-15	0.3722	50.0000	613.5000	4.6173	1.1148	0.0175	27.5N
29-09A-16	0.2196	50.0000	617.0000	4.3226	1.1152	0.0175	27.5N
29-09A-17	0.1877	50.2500	619.5000	4.0078	1.1158	0.0175	27.5N
29-09A-18	0.1385	49.5000	613.0000	3.8093	1.1144	0.0175	27.5N
29-09A-19	0.1041	50.0000	611.5000	3.5366	1.1135	0.0175	27.5N
29-09A-20	0.2052	50.0000	620.0000	4.1261	1.1604	0.0175	27.5N
29-09A-21	0.2802	49.5000	622.0000	4.3662	1.1605	0.0175	27.5N
29-09A-22	0.3197	50.0000	624.0000	4.4208	1.1570	0.0175	27.5N
29-09A-23	0.3586	49.0000	621.5000	4.7115	1.1564	0.0175	27.5N
29-09A-24	0.2995	50.5000	623.0000	4.2798	1.1595	0.0175	27.5N
29-10A-1	0.1477	49.5000	613.0000	5.2593	1.2534	0.0172	2
29-10A-2	0.1814	50.0000	611.0000	5.2067	1.2515	0.0172	2
29-10A-3	0.2154	50.0000	614.5000	5.1085	1.2463	0.0172	2
29-10A-4	0.2490	50.0000	614.0000	5.1085	1.2476	0.0172	2
29-10A-5	0.2826	49.5000	611.5000	5.1601	1.2472	0.0172	2
29-10A-6	0.1673	50.0000	612.0000	3.8314	1.1089	0.0176	2
29-10A-7	0.2042	50.0000	613.5000	4.1261	1.1139	0.0176	2
29-10A-8	0.2374	50.0000	617.0000	4.2243	1.1344	0.0176	2
29-10A-9	0.2733	49.5000	613.5000	4.3662	1.1389	0.0176	2
29-10A-10	0.3197	49.5000	613.0000	4.3662	1.1049	0.0176	2
29-10A-11	0.2578	49.5000	739.0000	4.1678	1.0441	0.0176	2
29-10A-12	0.2923	49.2500	740.5000	4.2886	1.0641	0.0176	2
29-10A-13	0.3339	49.5000	739.0000	4.3662	1.0573	0.0176	2
29-10A-14	0.2065	49.0000	733.5000	4.1100	1.1012	0.0176	2
29-10A-15	0.1716	49.5000	727.5000	3.9693	1.0798	0.0176	2
29-10A-16	0.2352	49.5000	680.0000	4.2670	1.1433	0.0176	2
29-10A-17	0.2682	50.0000	661.0000	4.3226	1.1588	0.0176	2
29-10A-18	0.3090	50.0000	672.0000	4.3226	1.1413	0.0176	2
29-10A-19	0.1905	50.0000	657.0000	3.9296	1.1926	0.0176	2
29-10A-20	0.2568	49.0000	664.0000	4.5110	1.1466	0.0161	27.5N
29-10A-21	0.2957	49.0000	665.0000	4.5110	1.1487	0.0161	27.5N
29-10A-22	0.3393	49.0000	662.0000	4.3105	1.1439	0.0161	27.5N
29-10A-23	0.2337	49.0000	661.0000	4.4106	1.1544	0.0161	27.5N
29-10A-24	0.2123	49.5000	666.5000	4.1678	1.1473	0.0161	27.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-10A-25	0.1269	100.0000	628.0000	3.1437	2.2662	0.0161	2/.5N
29-10A-26	0.1496	100.5000	633.5000	3.1280	2.2574	0.0161	2/.5N
29-10A-27	0.2025	89.0000	654.0000	3.1459	1.9432	0.0161	2/.5N
29-10A-28	0.2113	88.0000	677.5000	3.2375	1.8804	0.0161	2/.5N
29-10A-29	0.2430	100.0000	648.0000	1.6210	1.6750	0.0161	2/.5N
29-10A-30	0.2504	100.0000	667.0000	1.7683	1.5834	0.0161	2/.5N
29-11A-1	0.0	50.0000	604.0000	2.0000	0.8191	0.0163	2
29-11B-1	0.3567	126.5000	679.0000	1.5810	1.7035	0.0158	2
29-11B-2	0.3639	125.7500	641.5000	1.4314	1.6692	0.0158	2
29-12A-1	0.2685	147.2500	621.5000	2.8523	2.7106	0.0167	2
29-12A-2	0.2847	150.7500	628.5000	2.7197	2.7011	0.0167	2
29-12A-3	0.3018	154.7500	648.5000	2.5848	2.6853	0.0167	2
29-12A-4	0.3246	155.7500	657.5000	2.5682	2.6250	0.0167	2
29-12A-5	0.2578	148.7500	653.0000	2.8908	2.6732	0.0167	2
29-12A-6	0.3015	152.7500	653.0000	2.7496	2.6968	0.0172	2/.5N
29-12A-7	0.2830	150.7500	650.5000	2.7861	2.6815	0.0172	2/.5N
29-12A-8	0.2663	149.7500	649.5000	2.8047	2.6847	0.0172	2/.5N
29-12A-9	0.2527	148.2500	646.0000	2.8331	2.6856	0.0172	2/.5N
29-12A-10	0.3478	154.7500	649.0000	2.4556	2.7048	0.0172	2/.5N
29-13A-1	0.1687	49.7500	644.0000	5.0251	1.0997	0.0190	2
29-13A-2	0.2073	50.2500	625.5000	4.7761	1.0987	0.0190	2
29-13A-3	0.2946	49.7500	645.5000	5.0251	1.0594	0.0190	2
29-13B-1	0.2452	49.7500	656.0000	5.4303	1.0828	0.0201	2
29-13B-2	0.2117	49.2500	661.0000	5.2660	1.0753	0.0201	2
29-13B-3	0.1708	49.2500	649.0000	5.0865	1.0868	0.0201	2
29-13B-4	0.1275	50.5000	613.5000	4.8634	1.1174	0.0201	2
29-13B-5	0.1009	50.0000	602.0000	4.9120	1.1223	0.0201	2
29-13B-6	0.1754	50.5000	599.0000	5.0579	1.1241	0.0195	2/.5N
29-13B-7	0.0894	50.0000	611.0000	4.9120	1.1136	0.0195	2/.5N
29-13B-8	0.1295	50.5000	575.5000	4.7661	1.1328	0.0195	2/.5N
29-13B-9	0.2188	50.2500	625.0000	5.1808	1.0965	0.0195	2/.5N
29-13B-10	0.2597	50.5000	647.5000	5.2524	1.0906	0.0195	2/.5N
29-14A-1	0.2305	50.5000	645.5000	4.1825	1.0756	0.0185	2
29-14A-2	0.1861	50.0000	618.5000	4.3226	1.1071	0.0185	2
29-14A-3	0.1647	50.0000	601.0000	4.4208	1.1237	0.0185	2
29-14A-4	0.1271	50.0000	614.0000	4.4208	1.1169	0.0185	2
29-14A-5	0.2579	50.0000	604.0000	4.7155	1.1263	0.0185	2
29-14A-6	0.1436	50.0000	604.5000	4.2243	1.1233	0.0174	2/.5N
29-14A-7	0.1735	50.0000	599.0000	4.5190	1.1217	0.0174	2/.5N
29-14A-8	0.2124	50.5000	601.0000	4.4743	1.1149	0.0174	2/.5N
29-14A-9	0.2552	50.0000	634.5000	4.7155	1.0961	0.0174	2/.5N
29-14A-10	0.1822	50.0000	691.0000	4.1261	1.0672	0.0181	2/.5N
29-14A-11	0.2138	50.5000	611.5000	4.1825	1.1070	0.0181	2/.5N
29-14A-12	0.2526	50.0000	606.0000	4.3226	1.1072	0.0181	2/.5N
29-15A-1	0.1647	49.5000	594.0000	5.6562	1.1230	0.0179	2
29-15A-2	0.2027	50.0000	597.5000	5.7962	1.1185	0.0179	2
29-15A-3	0.2396	50.0000	583.5000	5.8944	1.1207	0.0179	2
29-15A-4	0.2764	50.0000	584.0000	5.9926	1.1227	0.0179	2
29-15A-5	0.3142	50.0000	586.5000	6.1891	1.1208	0.0179	2
29-15A-6	0.2109	50.0000	595.0000	5.8944	1.1224	0.0172	2/.5N
29-15A-7	0.2500	49.5000	591.0000	6.0532	1.1167	0.0172	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-15A-8	0.1924	49.5000	593.0000	6.0532	1.1208	0.0172	2/.5N
29-15A-9	0.2898	50.0000	587.5000	6.2874	1.1160	0.0172	2/.5N
29-15A-10	0.1811	49.5000	597.0000	6.2516	1.1243	0.0172	2/.5N
29-15A-11	0.1792	50.0000	591.5000	6.1891	1.1190	0.0179	2/.5N
29-15A-12	0.2166	50.0000	590.5000	6.4838	1.1181	0.0179	2/.5N
29-15A-13	0.2556	50.5000	633.0000	6.8087	1.0929	0.0179	2/.5N
29-15A-14	0.1461	50.0000	672.0000	6.2874	1.0788	0.0179	2/.5N
29-15A-15	0.1450	50.0000	586.5000	6.0909	1.1209	0.0179	2/.5N
29-15A-16	0.1365	50.0000	581.5000	5.8944	1.1299	0.0170	2/.5N
29-15A-17	0.1779	50.0000	591.5000	6.2874	1.1240	0.0170	2/.5N
29-15A-18	0.2111	50.5000	592.0000	6.3224	1.1199	0.0170	2/.5N
29-15A-19	0.2495	50.0000	604.0000	6.6803	1.1197	0.0170	2/.5N
29-16A-1	0.2331	50.0000	589.0000	5.2067	0.9723	0.0152	2
29-16A-2	0.2762	50.0000	575.5000	5.3050	0.9716	0.0152	2
29-16A-3	0.3163	50.0000	594.5000	5.4032	0.9804	0.0152	2
29-16A-4	0.1426	50.0000	570.0000	5.1085	0.9950	0.0152	2
29-16A-5	0.2067	50.0000	586.5000	5.2067	0.9779	0.0161	2/.5N
29-16A-6	0.2487	50.0000	578.0000	5.3050	0.9817	0.0161	2/.5N
29-16A-7	0.2959	50.0000	575.5000	5.4032	0.9836	0.0161	2/.5N
29-16A-8	0.2055	50.0000	577.5000	5.4032	0.9769	0.0167	2/.5N
29-16A-9	0.1540	50.5000	583.0000	5.7388	1.0068	0.0167	2/.5N
29-16A-10	0.1593	50.0000	570.0000	5.3050	0.9891	0.0167	2/.5N
29-16A-11	0.1934	50.0000	583.0000	5.5014	0.9793	0.0167	2
29-17A-1	0.2131	50.0000	680.5000	4.4208	1.0647	0.0170	2
29-17A-2	0.2523	50.0000	681.5000	4.5190	1.0647	0.0170	2
29-17A-3	0.2913	50.0000	675.5000	4.7155	1.0654	0.0170	2
29-17A-4	0.3208	50.0000	674.5000	4.7155	1.0975	0.0170	2
29-17A-5	0.2209	50.0000	687.0000	4.5190	1.0710	0.0176	2/.5N
29-17A-6	0.2574	50.0000	689.0000	4.7155	1.0868	0.0176	2/.5N
29-17A-7	0.2368	50.0000	687.5000	4.9120	1.0631	0.0176	2/.5N
29-17A-8	0.1785	50.0000	693.5000	4.6173	1.0646	0.0176	2/.5N
29-17A-9	0.1322	50.0000	699.0000	4.5190	1.0578	0.0176	2/.5N
29-17A-10	0.1277	50.0000	700.0000	4.7155	1.0574	0.0170	2/.5N
29-17A-11	0.1071	50.0000	740.5000	5.2067	1.0480	0.0170	2/.5N
29-18A-1	0.2107	50.0000	672.5000	4.5190	1.0757	0.0176	2/.5N
29-18A-2	0.2621	50.0000	662.0000	4.7155	1.0853	0.0176	2/.5N
29-18A-3	0.2714	50.0000	668.5000	4.7155	1.0856	0.0176	2/.5N
29-18A-4	0.2905	50.0000	665.5000	4.8138	1.0771	0.0176	2/.5N
29-18A-5	0.2641	50.0000	673.0000	4.9120	1.0822	0.0176	2/.5N
29-18A-6	0.2311	50.0000	676.5000	4.9120	1.0782	0.0176	2/.5N
29-18A-7	0.1943	50.0000	674.0000	4.5190	1.0790	0.0176	2/.5N
29-18A-8	0.1948	50.0000	678.0000	4.8138	1.0740	0.0176	2/.5N
29-18A-9	0.1937	50.0000	692.5000	5.0102	1.0692	0.0176	2/.5N
29-18A-10	0.1931	50.0000	691.0000	5.0102	1.0740	0.0176	2/.5N
29-18A-11	0.1264	50.0000	692.0000	4.9120	1.0732	0.0176	2/.5N
29-18A-12	0.1249	50.0000	688.5000	5.2067	1.0688	0.0176	2/.5N
29-18A-13	0.1250	50.0000	712.0000	5.0102	1.0572	0.0176	2/.5N
29-18A-14	0.1227	50.0000	670.5000	4.6173	1.0845	0.0176	2/.5N
29-18A-15	0.1935	50.0000	679.0000	4.6173	1.0789	0.0176	2/.5N
29-18A-16	0.2362	50.0000	689.5000	4.9120	1.0778	0.0176	2/.5N
29-18A-17	0.2357	50.0000	689.0000	4.8138	1.0734	0.0176	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-18A-18	0.2359	50.0000	693.5000	5.0102	1.0746	0.0176	2/.5N
29-19A-1	0.2052	50.0000	671.0000	4.5190	1.1342	0.0176	2/.5N
29-19A-2	0.2054	50.0000	679.5000	4.5190	1.1332	0.0176	2/.5N
29-19A-3	0.2073	50.0000	685.0000	4.5190	1.1230	0.0176	2/.5N
29-19A-4	0.2067	50.0000	690.0000	4.5190	1.1254	0.0176	2/.5N
29-19A-5	0.2498	50.0000	675.5000	4.3226	1.1197	0.0176	2/.5N
29-19A-6	0.1732	50.0000	668.5000	3.9296	1.1239	0.0176	2/.5N
29-19A-7	0.1756	50.0000	686.0000	4.4208	1.1080	0.0176	2/.5N
29-19A-8	0.1302	50.0000	709.5000	4.5190	1.1117	0.0176	2/.5N
29-19A-9	0.1741	50.0000	684.5000	4.6173	1.1182	0.0176	2/.5N
29-19A-10	0.1743	50.0000	696.5000	5.1065	1.1169	0.0176	2/.5N
29-19A-11	0.1744	50.0000	708.0000	5.1085	1.1159	0.0176	2/.5N
29-19A-12	0.1741	50.0000	701.5000	4.9120	1.1176	0.0176	2/.5N
29-19A-13	0.2080	50.0000	681.0000	4.7155	1.1382	0.0176	2/.5N
29-19A-14	0.2099	50.0000	681.0000	4.7155	1.1278	0.0176	2/.5N
29-19A-15	0.2491	50.0000	675.0000	4.6173	1.1225	0.0176	2/.5N
29-19A-16	0.0864	50.0000	673.0000	4.1261	1.1357	0.0176	2/.5N
29-19A-17	0.0905	50.0000	756.0000	5.0102	1.0831	0.0176	2/.5N
29-19A-18	0.1255	50.0000	676.5000	4.3226	1.1523	0.0176	2/.5N
29-19A-19	0.1282	50.0000	726.5000	5.1085	1.1282	0.0176	2/.5N
29-19A-20	0.1283	50.0000	763.0000	5.4032	1.1276	0.0176	2/.5N
29-19A-21	0.1258	50.0000	638.0000	4.6173	1.1541	0.0185	2/.5N
29-19A-22	0.1693	50.0000	633.5000	4.6173	1.1525	0.0185	2/.5N
29-19A-23	0.2077	50.0000	630.5000	4.8138	1.1427	0.0185	2/.5N
29-19A-24	0.2457	50.0000	634.5000	5.0102	1.1410	0.0185	2/.5N
29-19A-25	0.0902	50.0000	632.0000	4.7155	1.1414	0.0185	2/.5N
29-19A-26	0.0908	50.0000	645.5000	4.9120	1.1331	0.0176	2/.5N
29-19A-27	0.1275	50.0000	650.0000	5.2067	1.1359	0.0176	2/.5N
29-19A-28	0.1756	50.0000	644.5000	5.4032	1.1353	0.0176	2/.5N
29-19A-29	0.2091	50.0000	645.5000	5.5014	1.1345	0.0176	2/.5N
29-19A-30	0.0947	50.0000	644.5000	5.3050	1.1348	0.0170	2/.5N
29-19A-31	0.1276	50.0000	641.0000	5.4032	1.1360	0.0170	2/.5N
29-19A-32	0.1075	50.0000	650.0000	5.3050	1.1293	0.0170	2/.5N
29-19A-33	0.1496	50.0000	647.0000	5.5014	1.1334	0.0170	2/.5N
29-19A-34	0.1343	126.0000	625.5000	3.4127	2.7389	0.0167	2/.5N
29-19A-35	0.1350	125.0000	622.0000	3.8400	2.7562	0.0167	2/.5N
29-19A-36	0.1522	126.0000	643.5000	2.9365	2.4132	0.0167	2/.5N
29-19A-37	0.1810	127.0000	625.0000	3.2283	2.5191	0.0167	2/.5N
29-19A-38	0.2256	125.0000	630.0000	3.0400	2.3870	0.0167	2/.5N
29-19A-39	0.2200	129.0000	634.0000	2.8682	2.4660	0.0165	2/.5N
29-19A-40	0.1933	128.0000	629.5000	2.4219	2.3550	0.0165	2/.5N
29-19A-41	0.1587	125.0000	630.0000	2.4000	2.3096	0.0165	2/.5N
29-19A-42	0.2109	127.0000	763.5000	2.2835	2.1621	0.0165	2/.5N
29-19A-43	0.2584	150.0000	727.5000	1.4667	1.7617	0.0163	2/.5N
29-19A-44	0.2459	149.0000	751.5000	1.2752	1.6680	0.0163	2/.5N
29-19A-45	0.2075	150.0000	756.0000	1.3333	1.7395	0.0163	2/.5N
29-20A-1	0.1250	51.0000	624.0000	4.6231	1.1621	0.0169	2/.5N
29-20A-2	0.1656	50.0000	634.0000	4.9120	1.1510	0.0169	2/.5N
29-20A-3	0.2052	50.0000	632.5000	4.9120	1.1572	0.0169	2/.5N
29-20A-4	0.2424	50.0000	633.0000	4.9120	1.1567	0.0169	2/.5N
29-20A-5	0.2808	50.0000	636.5000	4.9120	1.1550	0.0169	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-20A-6	0.1261	50.0000	623.5000	4.9120	1.1621	0.0190	2
29-20A-7	0.1603	50.0000	634.5000	4.9120	1.1562	0.0190	2
29-20A-8	0.1965	50.0000	635.5000	4.9120	1.1566	0.0190	2
29-20A-9	0.2317	50.0000	631.0000	4.9120	1.1608	0.0190	2
29-20A-10	0.2696	50.0000	633.0000	4.9120	1.1533	0.0190	2
29-20A-11	0.2876	50.0000	639.5000	4.9120	1.1537	0.0190	2
29-21A-1	0.0903	50.0000	602.0000	3.4384	1.0897	0.0172	2/.5N
29-21A-2	0.1345	50.0000	599.5000	4.1261	1.0791	0.0172	2/.5N
29-21A-3	0.1798	50.0000	599.5000	4.2243	1.0845	0.0172	2/.5N
29-21A-4	0.2177	50.0000	601.5000	4.2243	1.0897	0.0172	2/.5N
29-21A-5	0.1827	50.0000	598.0000	4.2243	1.0906	0.0172	2/.5N
29-21A-6	0.1610	50.0000	598.0000	4.3226	1.0856	0.0172	2/.5N
29-21A-7	0.1333	50.0000	600.5000	4.1261	1.0891	0.0172	2/.5N
29-21A-8	0.1977	50.0000	598.5000	4.2243	1.0932	0.0172	2/.5N
29-21A-9	0.1119	50.0000	600.5000	4.2243	1.0860	0.0172	2/.5N
29-21A-10	0.0669	50.0000	600.5000	4.4208	1.0993	0.0168	2/.5N
29-21A-11	0.0901	50.0000	600.0000	4.5190	1.0928	0.0168	2/.5N
29-21A-12	0.1106	52.6000	601.0000	4.3452	1.0995	0.0168	2/.5N
29-21A-13	0.1361	52.6000	603.0000	4.0618	1.0669	0.0168	2/.5N
29-21A-14	0.1616	52.5000	604.0000	3.9296	1.0509	0.0168	2/.5N
29-21A-15	0.1856	52.5000	599.5000	3.9296	1.0512	0.0168	2/.5N
29-22A-1	0.1467	50.0000	599.5000	3.7331	1.3593	0.0176	2/.5N
29-22A-2	0.1751	50.0000	602.5000	3.8314	1.3559	0.0176	2/.5N
29-22A-3	0.2072	50.0000	605.0000	3.9296	1.3532	0.0176	2/.5N
29-22A-4	0.2388	50.0000	604.0000	3.9296	1.3581	0.0176	2/.5N
29-22A-5	0.2703	50.0000	595.0000	4.2243	1.3644	0.0176	2/.5N
29-22A-6	0.1114	50.0000	606.0000	4.5190	1.3465	0.0176	2/.5N
29-22A-7	0.1440	50.0000	604.5000	3.7331	1.3544	0.0176	2/.5N
29-22A-8	0.2075	50.0000	605.5000	3.8314	1.3506	0.0176	2/.5N
29-23A-1	0.1299	50.0000	359.5000	3.7331	1.0849	0.0171	2/.5N
29-23A-2	0.1791	50.0000	371.0000	4.0278	1.0929	0.0171	2/.5N
29-23A-3	0.2149	50.0000	347.5000	3.9880	1.1073	0.0171	2/.5N
29-23A-4	0.1309	50.0000	346.0000	4.1261	1.1486	0.0171	2/.5N
29-23A-5	0.1612	50.0000	704.5000	4.0278	0.9025	0.0171	2/.5N
29-23A-6	0.2118	50.0000	671.0000	4.1261	0.9311	0.0171	2/.5N
29-24A-1	0.2201	50.0000	653.5000	3.4384	0.6612	0.0192	2/.5N
29-24A-2	0.2622	50.0000	658.0000	3.4384	0.6297	0.0192	2/.5N
29-24A-3	0.1854	50.0000	661.0000	3.4384	0.6567	0.0192	2/.5N
29-24A-4	0.1530	50.0000	649.5000	3.2419	0.6445	0.0192	2/.5N
29-24A-5	0.1145	49.5000	657.0000	3.2747	0.6630	0.0192	2/.5N
29-24A-6	0.1201	50.0000	334.0000	3.4384	0.8205	0.0192	2/.5N
29-24A-7	0.1486	49.5000	336.0000	3.4731	0.8187	0.0192	2/.5N
29-24A-8	0.1763	50.0000	335.0000	3.4384	0.7973	0.0192	2/.5N
29-24A-9	0.2102	50.0000	339.5000	3.6349	0.8084	0.0192	2/.5N
29-24A-10	0.2492	50.0000	341.5000	3.6000	0.7835	0.0192	2/.5N
29-25A-1	0.1143	50.0000	659.0000	3.7331	0.8599	0.0170	2/.5N
29-25A-2	0.2255	50.0000	654.5000	4.2243	0.8641	0.0170	2/.5N
29-25A-3	0.2723	50.0000	656.5000	4.6173	0.8708	0.0170	2/.5N
29-25A-4	0.3195	50.0000	647.5000	4.7155	0.8763	0.0170	2/.5N
29-25A-5	0.3691	50.0000	656.0000	5.1085	0.8771	0.0170	2/.5N
29-25A-6	0.4187	50.0000	654.0000	5.4032	0.8794	0.0170	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-25A-7	0.4496	50.0000	648.5000	5.4032	0.8681	0.0170	2/.5N
29-26A-1	0.2620	50.0000	625.0000	4.7155	0.9040	0.0190	2/.5N
29-26A-2	0.1599	49.5000	627.5000	4.6639	0.9063	0.0190	2/.5N
29-26A-3	0.3605	50.0000	633.5000	5.1085	0.8974	0.0190	2/.5N
29-27A-1	0.2732	50.0000	678.0000	6.4838	0.8665	0.0195	2/.5N
29-27A-2	0.2760	50.0000	657.0000	6.0909	0.8574	0.0195	2/.5N
29-27A-3	0.2767	50.0000	664.0000	6.0909	0.8548	0.0195	2/.5N
29-27A-4	0.3657	50.0000	630.0000	5.3050	0.8827	0.0195	2/.5N
29-27A-5	0.3477	50.0000	637.5000	5.4032	0.8957	0.0181	2
29-28A-1	0.1636	50.0000	643.5000	4.7155	0.8860	0.0190	2/.5N
29-28A-2	0.2167	50.0000	631.0000	4.9120	0.8989	0.0190	2/.5N
29-28A-3	0.2656	49.5000	634.5000	5.2593	0.8918	0.0190	2/.5N
29-28A-4	0.3143	49.5000	634.0000	5.2593	0.8900	0.0190	2/.5N
29-28A-5	0.3614	49.5000	632.5000	5.4578	0.8947	0.0190	2/.5N
29-28A-6	0.3888	50.0000	634.0000	5.4032	0.8881	0.0190	2/.5N
29-28A-7	0.1638	50.0000	635.5000	4.8138	0.8839	0.0190	2/.5N
29-28A-8	0.1367	50.0000	635.5000	4.6173	0.8872	0.0190	2/.5N
29-28A-9	0.1100	49.5000	637.0000	4.3662	0.8925	0.0190	2/.5N
29-28A-10	0.2180	49.5000	662.0000	6.4501	0.8937	0.0190	2/.5N
29-28A-11	0.1967	50.0000	656.0000	5.8944	0.8617	0.0190	2/.5N
29-28A-12	0.2479	50.0000	649.5000	5.9926	0.8708	0.0190	2/.5N
29-28A-13	0.2719	50.0000	654.0000	6.2874	0.8711	0.0190	2/.5N
29-28A-14	0.2918	49.5000	661.5000	6.6486	0.8850	0.0190	2/.5N
29-28A-15	0.2838	49.5000	643.5000	5.4578	0.8756	0.0184	2
29-28A-16	0.3280	50.0000	632.0000	5.5997	0.8871	0.0184	2
29-28A-17	0.3833	50.0000	640.5000	5.5014	0.8687	0.0184	2
29-28A-18	0.3556	50.0000	638.0000	5.5014	0.8776	0.0184	2
29-28A-19	0.2987	49.5000	643.0000	5.7555	0.9044	0.0184	2
29-28A-20	0.2823	50.0000	635.5000	5.5997	0.8828	0.0184	2
29-29A-1	0.1285	100.0000	620.5000	4.5682	1.9380	0.0190	2
29-29A-2	0.1382	99.0000	623.0000	4.6639	1.9542	0.0203	2
29-29A-3	0.1498	100.0000	569.0000	4.6173	1.9428	0.0203	2
29-29A-4	0.2043	100.0000	596.0000	4.7646	1.9376	0.0203	2
29-29A-5	0.1253	100.0000	549.0000	4.4208	1.9666	0.0203	2
29-30A-1	0.2370	50.0000	632.5000	4.5190	0.9621	0.0183	2
29-30A-2	0.2793	50.0000	627.0000	4.7155	0.9658	0.0183	2
29-30A-3	0.3229	50.0000	628.5000	4.9120	0.9657	0.0183	2
29-30A-4	0.3696	50.0000	634.5000	5.0102	0.9569	0.0183	2
29-30A-5	0.3686	50.0000	630.5000	5.5014	0.9595	0.0197	2
29-30A-6	0.3700	50.0000	628.5000	5.4032	0.9555	0.0197	2
29-31A-1	0.3728	50.0000	631.5000	4.8138	0.9445	0.0165	2
29-31A-2	0.3552	50.0000	640.5000	5.0102	0.9914	0.0165	2
29-32A-1	0.3723	50.0000	645.0000	4.8138	0.9469	0.0150	2/.5N
29-32A-2	0.2845	50.0000	627.0000	3.9296	0.9436	0.0150	2/.5N
29-33A-1	0.2058	50.0000	618.5000	3.5366	0.9382	0.0167	2
29-33A-2	0.2547	50.0000	630.5000	3.5366	0.9225	0.0167	2
29-33A-3	0.2735	50.0000	619.5000	3.7331	0.9363	0.0167	2
29-33A-4	0.2937	50.0000	628.0000	3.7331	0.9450	0.0167	2
29-33A-5	0.3195	50.0000	622.0000	3.7331	0.9356	0.0167	2
29-33A-6	0.1947	50.0000	618.0000	3.3402	0.9467	0.0156	2/.5N
29-33A-7	0.2400	50.0000	623.5000	3.6349	0.9413	0.0156	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-33A-8	0.2671	50.0000	626.0000	3.5366	0.9235	0.0156	2/.5N
29-33A-9	0.2845	50.0000	624.5000	3.7331	0.9403	0.0156	2/.5N
29-33A-10	0.2573	50.0000	624.0000	3.8314	0.9594	0.0156	2/.5N
29-33A-11	0.2834	50.0000	619.5000	3.8314	0.9435	0.0156	2/.5N
29-34A-1	0.0	50.0000	640.0000	3.8314	1.0488	0.0165	2
29-35A-1	0.1675	80.0000	604.0000	2.3946	1.3545	0.0176	2
29-35A-2	0.1960	80.0000	593.5000	2.4560	1.3706	0.0176	2
29-35A-3	0.2606	80.0000	604.5000	2.5788	1.3520	0.0176	2
29-35A-4	0.3281	83.0000	593.5000	2.4856	1.3289	0.0176	2
29-35A-5	0.3885	84.5000	605.0000	2.4415	1.3368	0.0176	2
29-35A-1	0.4153	86.0000	601.0000	2.4560	1.3511	0.0176	2
29-36A-1	0.2344	50.0000	607.5000	4.0278	0.9676	0.0159	2
29-36A-2	0.2741	50.0000	602.0000	3.8314	0.9793	0.0159	2
29-36A-3	0.2963	50.0000	603.5000	3.7331	0.9774	0.0159	2
29-36A-4	0.3178	50.0000	600.5000	3.8314	0.9775	0.0159	2
29-36A-5	0.3396	50.0000	603.0000	3.8314	0.9763	0.0159	2
29-36A-6	0.3519	50.0000	606.0000	3.8314	0.9777	0.0159	2
29-36A-7	0.3746	50.0000	603.0000	3.8314	0.9743	0.0159	2
29-36A-8	0.2058	50.0000	603.5000	4.0278	0.9998	0.0159	2
29-36A-9	0.1873	50.0000	606.5000	4.1261	0.9874	0.0159	2
29-36A-10	0.1640	50.0000	605.0000	4.1261	0.9975	0.0159	2
29-36A-11	0.1419	50.0000	600.5000	4.1261	0.9997	0.0159	2
29-36A-12	0.1201	50.0000	600.0000	4.0278	0.9980	0.0159	2
29-37A-1	0.2000	50.0000	600.5000	3.6349	1.1385	0.0185	2
29-37A-2	0.2384	50.0000	604.0000	3.7331	1.1305	0.0185	2
29-37A-3	0.2563	50.0000	601.5000	3.8314	1.1330	0.0185	2
29-37A-4	0.2738	50.0000	605.0000	3.8314	1.1373	0.0185	2
29-37A-5	0.2920	50.0000	601.5000	3.9296	1.1382	0.0185	2
29-37A-6	0.3111	50.0000	602.0000	3.9296	1.1354	0.0185	2
29-37A-7	0.1818	50.0000	604.5000	3.5366	1.1366	0.0185	2
29-37A-8	0.1449	50.0000	605.0000	3.6349	1.1332	0.0185	2
29-37A-9	0.2068	50.0000	602.5000	3.6349	1.1438	0.0165	2/.5N
29-37A-10	0.2457	50.0000	602.0000	3.7331	1.1369	0.0165	2/.5N
29-37A-11	0.2847	50.0000	603.0000	3.9296	1.1349	0.0165	2/.5N
29-37A-12	0.3049	50.0000	604.0000	3.9296	1.1327	0.0165	2/.5N
29-37A-13	0.2652	50.0000	602.0000	3.7331	1.1352	0.0165	2/.5N
29-37A-14	0.3218	50.0000	600.5000	3.9296	1.1422	0.0165	2/.5N
29-37A-15	0.1882	50.0000	598.5000	3.6349	1.1441	0.0165	2/.5N
29-37A-16	0.1484	50.0000	599.5000	3.6349	1.1388	0.0165	2/.5N
29-37A-17	0.0984	50.0000	605.0000	3.9296	1.1351	0.0165	2/.5N
29-38A-1	0.2245	50.0000	601.5000	4.1261	1.2030	0.0171	2
29-38A-2	0.2596	50.0000	602.0000	4.2243	1.2024	0.0171	2
29-38A-3	0.2596	50.0000	606.5000	4.2243	1.2014	0.0171	2
29-38A-4	0.2918	50.0000	600.0000	4.3226	1.2115	0.0171	2
29-38A-5	0.3117	50.0000	604.0000	4.3226	1.2008	0.0171	2
29-38A-6	0.2230	50.0000	600.5000	4.1261	1.2079	0.0171	2
29-38A-7	0.2318	50.0000	604.5000	4.3226	1.2049	0.0183	2/.5N
29-38A-8	0.2685	50.0000	601.5000	4.3226	1.2033	0.0183	2/.5N
29-38A-9	0.3055	50.0000	606.5000	4.3226	1.2032	0.0183	2/.5N
29-38A-10	0.2454	50.0000	600.0000	4.3226	1.2087	0.0183	2/.5N
29-38A-11	0.2728	50.0000	594.5000	4.4208	1.2159	0.0183	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-38A-12	0.2574	50.0000	599.0000	4.3226	1.2071	0.0183	2
29-38A-13	0.2322	50.0000	604.0000	3.9296	1.1601	0.0154	2
29-38A-14	0.2672	50.0000	600.5000	3.9296	1.1649	0.0154	2
29-38A-15	0.2856	50.0000	600.5000	4.0278	1.1633	0.0154	2
29-38A-16	0.3025	50.0000	604.5000	4.0278	1.1675	0.0154	2
29-38A-17	0.3219	50.0000	601.5000	3.8314	1.1617	0.0154	2
29-38A-18	0.3404	50.0000	604.0000	3.8314	1.1603	0.0154	2
29-38A-19	0.2177	50.0000	601.0000	4.3226	1.2524	0.0140	2/.5N
29-38A-20	0.2434	49.5000	600.5000	4.4655	1.2540	0.0140	2/.5N
29-38A-21	0.2575	50.0000	603.0000	4.5190	1.2541	0.0140	2/.5N
29-38A-22	0.2756	50.0000	606.5000	4.6173	1.2516	0.0140	2/.5N
29-38A-23	0.2929	50.0000	600.5000	4.6173	1.2537	0.0140	2/.5N
29-38A-24	0.2243	49.0000	604.0000	2.3056	0.9594	0.0140	2/.5N
29-38A-25	0.2526	49.0000	607.0000	2.5061	0.9352	0.0140	2/.5N
29-38A-26	0.2679	50.0000	599.5000	2.4560	0.9289	0.0140	2/.5N
29-38A-27	0.2729	49.5000	606.5000	2.4808	0.9429	0.0140	2/.5N
29-38A-28	0.2857	50.0000	598.5000	2.5542	0.9462	0.0140	2/.5N
29-38A-29	0.3016	50.0000	597.5000	2.4560	0.9538	0.0140	2/.5N
29-39A-1	0.2592	49.5000	589.5000	5.5570	1.0864	0.0152	2
29-39A-2	0.2580	49.7500	605.0000	5.5291	1.0738	0.0152	2
29-39A-3	0.2713	50.0000	605.5000	5.5050	1.0676	0.0152	2
29-39A-4	0.2882	49.0000	598.5000	5.4132	1.0770	0.0152	2
29-39A-5	0.3088	50.0000	605.5000	5.0102	1.0728	0.0152	2
29-40A-1	0.2902	50.0000	602.0000	4.6173	1.0008	0.0171	2
29-40A-2	0.3309	50.0000	605.0000	4.7155	1.0040	0.0171	2
29-40A-3	0.3735	50.0000	600.0000	4.8138	1.0017	0.0171	2
29-40A-4	0.4761	50.0000	604.0000	5.3050	1.0061	0.0171	2
29-40A-5	0.4946	50.0000	601.0000	5.4032	1.0109	0.0159	2
29-40A-6	0.5331	50.0000	601.5000	5.5997	1.0161	0.0159	2
29-40A-7	0.5749	50.0000	599.5000	5.2067	1.0142	0.0159	2
29-40A-8	0.6178	50.0000	603.5000	5.2067	1.0115	0.0159	2
29-40A-9	0.2646	50.0000	599.0000	4.3226	1.0170	0.0159	2
29-40A-10	0.2455	50.0000	599.0000	4.6173	1.0118	0.0159	2
29-40A-11	0.2253	50.0000	605.0000	4.7155	1.0091	0.0159	2
29-41A-1	0.5258	49.5000	603.5000	5.0608	0.8708	0.0161	2
29-41A-2	0.5427	50.0000	601.5000	5.1085	0.8823	0.0161	2
29-41A-3	0.4749	50.5000	606.0000	4.7661	0.8757	0.0161	2
29-41A-4	0.4248	50.0000	603.0000	4.8138	0.8799	0.0161	2
29-42A-1	0.4248	50.0000	603.0000	4.8138	0.8796	0.0166	2
29-42A-2	0.4610	49.5000	602.5000	5.0608	0.9017	0.0166	2
29-42A-3	0.5114	50.0000	603.5000	5.2067	0.8942	0.0166	2
29-43A-1	0.2426	49.5000	606.0000	4.3662	0.9356	0.0125	2
29-43A-2	0.2903	50.0000	605.5000	4.5190	0.9260	0.0125	2
29-43A-3	0.3371	50.0000	603.0000	4.5190	0.9215	0.0125	2
29-43A-4	0.3629	50.0000	605.5000	4.5190	0.9137	0.0125	2
29-43A-5	0.3803	49.5000	608.5000	4.6639	0.9262	0.0125	2
29-43A-6	0.4040	50.0000	610.0000	4.7155	0.9236	0.0125	2
29-43A-7	0.4199	50.0000	603.5000	4.9120	0.9385	0.0125	2
29-43A-8	0.4457	50.0000	595.0000	4.9120	0.9310	0.0125	2
29-43A-9	0.4669	49.5000	600.0000	5.0608	0.9335	0.0125	2
29-43A-10	0.3076	50.0000	601.0000	4.5190	0.9274	0.0125	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-43A-11	0.3501	50.0000	606.0000	4.4208	0.9211	0.0125	2/.5N
29-43A-12	0.3947	50.0000	605.0000	4.6173	0.9296	0.0125	2/.5N
29-43A-13	0.4437	50.0000	600.5000	4.7155	0.9272	0.0125	2/.5N
29-43A-14	0.4134	49.5000	600.5000	4.8624	0.9408	0.0125	2/.5N
29-43A-15	0.3771	50.0000	600.0000	4.5190	0.9252	0.0125	2/.5N
29-43A-16	0.3358	49.5000	599.5000	4.5647	0.9403	0.0125	2/.5N
29-43A-17	0.2955	49.5000	599.0000	4.5647	0.9434	0.0125	2/.5N
29-43A-18	0.2511	49.5000	600.0000	4.4655	0.9461	0.0125	2/.5N
29-44A-1	0.1922	50.0000	602.0000	3.7331	1.1698	0.0091	2
29-44A-2	0.2275	49.5000	603.5000	3.8701	1.1897	0.0091	2
29-44A-3	0.2622	49.5000	605.0000	3.9693	1.1921	0.0091	2
29-44A-4	0.2794	50.0000	600.5000	4.0278	1.1941	0.0091	2
29-44A-5	0.2980	50.0000	602.5000	4.0278	1.1897	0.0091	2
29-44A-6	0.3149	50.0000	602.0000	4.0278	1.1927	0.0091	2
29-44A-7	0.3327	50.0000	603.0000	4.1261	1.1921	0.0091	2
29-44A-8	0.3506	49.5000	605.0000	4.2670	1.1913	0.0091	2
29-44A-9	0.2016	50.0000	599.5000	3.7331	1.1966	0.0091	2/.5N
29-44A-10	0.2352	50.0000	604.0000	3.8314	1.1890	0.0091	2/.5N
29-44A-11	0.2726	50.0000	604.0000	3.9296	1.1883	0.0091	2/.5N
29-44A-12	0.3071	50.0000	598.5000	4.0278	1.1998	0.0091	2/.5N
29-44A-13	0.3275	50.0000	594.5000	4.0278	1.1935	0.0091	2/.5N
29-44A-14	0.2920	50.0000	605.0000	4.1261	1.1851	0.0091	2/.5N
29-45A-1	0.2234	49.5000	600.0000	4.5647	1.2076	0.0113	2
29-45A-2	0.2597	50.0000	603.0000	4.6173	1.1994	0.0113	2
29-45A-3	0.2764	50.0000	601.0000	4.7155	1.2029	0.0113	2
29-45A-4	0.2932	50.0000	602.5000	4.8138	1.2054	0.0113	2
29-45A-5	0.3107	49.5000	602.5000	4.9616	1.2042	0.0113	2
29-45A-6	0.1880	49.5000	597.5000	4.3662	1.2097	0.0113	2
29-45A-7	0.1543	49.5000	601.5000	4.2670	1.2022	0.0113	2
29-45A-8	0.1625	49.5000	605.5000	4.1678	1.1962	0.0113	2/.5N
29-45A-9	0.1961	49.0000	605.0000	4.4108	1.2066	0.0113	2/.5N
29-45A-10	0.2303	50.0000	593.0000	4.5190	1.2137	0.0113	2/.5N
29-45A-11	0.2679	49.5000	599.5000	4.7632	1.2066	0.0113	2/.5N
29-45A-12	0.2865	50.0000	601.0000	4.9120	1.2053	0.0113	2/.5N
29-45A-13	0.2580	50.0000	599.0000	4.7155	1.2052	0.0113	2/.5N
29-45B-1	0.1890	50.0000	601.5000	4.3226	1.2044	0.0113	2
29-45B-2	0.2234	50.0000	600.0000	4.6173	1.2067	0.0113	2
29-45B-3	0.2593	50.0000	604.5000	4.7155	1.2012	0.0113	2
29-45B-4	0.2760	50.0000	601.0000	4.9120	1.2045	0.0113	2
29-45B-5	0.2932	50.0000	600.5000	4.9120	1.2055	0.0113	2
29-45B-6	0.3107	50.0000	601.5000	5.0102	1.2051	0.0113	2
29-45B-7	0.3271	50.0000	599.5000	5.0102	1.2082	0.0113	2
29-45B-8	0.1968	50.0000	604.0000	4.3226	1.2026	0.0113	2/.5N
29-45B-9	0.2323	49.5000	602.5000	4.6639	1.2038	0.0113	2/.5N
29-45B-10	0.2654	50.0000	600.5000	4.9120	1.2181	0.0113	2/.5N
29-45B-11	0.2863	49.5000	602.0000	4.9616	1.2066	0.0113	2/.5N
29-45B-12	0.3046	50.0000	601.0000	5.0102	1.2077	0.0113	2/.5N
29-46A-1	0.1318	50.0000	605.5000	4.1261	1.0811	0.0130	2
29-46A-2	0.1715	50.0000	602.0000	3.9296	1.0818	0.0130	2
29-46A-3	0.2106	50.0000	605.0000	3.8314	1.0800	0.0130	2
29-46A-4	0.2484	50.0000	603.0000	3.9296	1.0839	0.0130	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-46A-5	0.1339	49.5000	604.0000	3.8701	1.0805	0.0130	2/.5N
29-46A-6	0.1803	50.0000	605.0000	3.9296	1.0785	0.0130	2/.5N
29-46A-7	0.2188	50.0000	604.0000	3.9296	1.0810	0.0130	2/.5N
29-46A-8	0.1988	50.0000	602.5000	3.8314	1.0841	0.0130	2/.5N
29-46A-9	0.1556	50.0000	599.0000	3.8314	1.0876	0.0130	2/.5N
29-46A-10	0.1982	50.5000	607.0000	3.7934	1.0872	0.0130	2/.5N
29-46A-11	0.1785	50.0000	598.0000	3.9296	1.0886	0.0130	2/.5N
29-46A-12	0.1344	49.0000	604.5000	3.8093	1.0756	0.0130	2/.5N
29-46A-13	0.1113	50.0000	601.5000	3.7331	1.0877	0.0130	2/.5N
29-47A-1	0.2269	50.0000	601.0000	3.9296	1.1872	0.0133	2
29-47A-2	0.2620	50.0000	601.5000	4.0278	1.1887	0.0133	2
29-47A-3	0.2983	50.0000	602.5000	4.1261	1.1844	0.0133	2
29-47A-4	0.3142	50.0000	600.5000	4.2243	1.1906	0.0133	2
29-47A-5	0.3332	49.5000	602.0000	4.2670	1.1861	0.0133	2
29-47A-6	0.3505	50.0000	603.0000	4.2243	1.1866	0.0133	2
29-47A-7	0.2345	50.0000	598.0000	3.9296	1.1912	0.0133	2/.5N
29-47A-8	0.2723	50.0000	603.0000	4.0278	1.1866	0.0133	2/.5N
29-47A-9	0.3128	50.0000	600.0000	4.1261	1.1868	0.0133	2/.5N
29-47A-10	0.3279	49.5000	600.5000	4.2670	1.1886	0.0133	2/.5N
29-47A-11	0.2902	49.5000	599.5000	4.1678	1.1887	0.0133	2/.5N
29-47A-12	0.1013	50.0000	603.0000	3.5366	1.1855	0.0133	2
29-47A-13	0.1060	49.5000	604.5000	3.5724	1.1854	0.0133	2/.5N
29-48A-1	0.2086	50.0000	598.5000	4.1261	1.1341	0.0121	2/.5N
29-48A-2	0.2282	50.0000	603.0000	4.1261	1.1296	0.0121	2/.5N
29-48A-3	0.1905	50.0000	603.0000	4.1261	1.1314	0.0121	2/.5N
29-48A-4	0.1718	50.0000	601.5000	4.1261	1.1312	0.0121	2/.5N
29-48A-5	0.2018	50.0000	602.0000	4.1261	1.1302	0.0121	2/.5N
29-48A-6	0.0868	50.0000	604.0000	3.9296	1.1301	0.0121	2/.5N
29-48A-7	0.1635	50.0000	604.0000	3.9296	1.1307	0.0121	2
29-48A-8	0.2005	50.0000	602.5000	4.1261	1.1314	0.0121	2
29-48A-9	0.2376	50.0000	602.5000	4.2243	1.1312	0.0121	2
29-48A-10	0.1822	50.0000	602.5000	4.1261	1.1315	0.0121	2
29-49A-1	0.0	50.0000	603.0000	2.4560	1.3242	0.0087	2
29-50A-1	0.2218	50.0000	597.5000	4.9120	0.8779	0.0080	2/.5N
29-50A-2	0.2769	50.0000	611.0000	5.1085	0.8559	0.0080	2/.5N
29-50A-3	0.2340	50.5000	601.0000	4.7661	0.8501	0.0080	2/.5N
29-50A-4	0.2127	50.0000	598.5000	4.4208	0.8784	0.0051	2
29-50A-5	0.2624	50.0000	600.5000	4.6173	0.8724	0.0051	2
29-50A-6	0.3088	50.5000	602.0000	4.8634	0.8774	0.0051	2
29-50A-7	0.3609	50.5000	604.5000	5.0579	0.8673	0.0051	2
29-50A-8	0.2396	50.2500	605.5000	4.4966	0.8670	0.0051	2
29-50A-9	0.1900	50.0000	597.0000	4.2243	0.8694	0.0051	2
29-50A-10	0.1631	50.0000	601.5000	4.2243	0.8781	0.0051	2
29-50A-11	0.1387	50.0000	603.0000	4.1261	0.8731	0.0051	2
29-50A-12	0.0999	49.2500	598.5000	4.6876	0.8969	0.0051	2
29-50A-13	0.2222	50.0000	606.0000	4.6173	0.8792	0.0051	2/.5N
29-50A-14	0.1869	50.0000	603.5000	4.9120	0.9003	0.0051	2/.5N
29-50A-15	0.2435	50.0000	595.5000	5.0102	0.8893	0.0051	2/.5N
29-50A-16	0.2329	50.0000	600.5000	4.8138	0.8843	0.0051	2/.5N
29-50A-17	0.2694	50.0000	602.5000	5.0102	0.8823	0.0051	2/.5N
29-50A-18	0.3196	50.0000	610.5000	5.0102	0.8778	0.0051	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-50A-19	0.2357	50.0000	595.0000	4.8138	0.8817	0.0051	2/.5N
29-51A-1	0.2745	50.0000	605.5000	2.8490	0.8665	0.0054	2/.5N
29-51A-2	0.2231	50.0000	598.5000	2.6525	0.8763	0.0054	2/.5N
29-51A-3	0.1637	50.0000	604.5000	1.2771	0.6027	0.0054	2/.5N
29-51A-4	0.1483	50.0000	602.5000	1.1739	0.5728	0.0054	2/.5N
29-51A-5	0.1091	50.0000	591.5000	1.1789	0.6136	0.0054	2/.5N
29-51A-6	0.2283	50.0000	599.5000	4.5190	1.0421	0.0076	2/.5N
29-51A-7	0.1876	50.0000	598.0000	4.3226	1.0432	0.0076	2/.5N
29-51A-8	0.1621	49.5000	597.5000	4.3662	1.0507	0.0076	2/.5N
29-51A-9	0.1397	50.0000	598.5000	4.2243	1.0424	0.0076	2/.5N
29-51A-10	0.1160	49.5000	598.0000	4.1678	1.0507	0.0076	2/.5N
29-51A-11	0.2072	49.5000	604.5000	4.7632	1.0466	0.0076	2/.5N
29-51A-12	0.1878	50.0000	601.5000	4.4208	1.0417	0.0076	2/.5N
29-51A-13	0.1830	50.0000	602.0000	4.4208	1.0439	0.0076	2/.5N
29-51A-14	0.1375	50.0000	602.0000	4.3226	1.0418	0.0076	2
29-51A-15	0.1585	50.0000	602.0000	4.3226	1.0419	0.0076	2
29-51A-16	0.1785	50.0000	601.5000	4.5190	1.0449	0.0076	2
29-51A-17	0.1827	50.0000	602.5000	4.5190	1.0437	0.0076	2
29-51A-18	0.1991	50.0000	604.0000	4.7155	1.0423	0.0076	2
29-51A-19	0.2190	50.0000	602.5000	4.8138	1.0436	0.0076	2
29-51A-20	0.2382	50.0000	604.5000	4.8138	1.0474	0.0076	2
29-52A-1	0.3159	49.5000	598.5000	5.8547	0.9855	0.0093	2/.5N
29-52A-2	0.2678	49.0000	605.0000	5.8142	0.8849	0.0093	2/.5N
29-52A-3	0.2237	49.5000	604.0000	5.5570	0.8705	0.0093	2/.5N
29-52A-4	0.2781	49.5000	602.0000	5.2593	0.8556	0.0105	2/.5N
29-52A-5	0.3059	50.0000	601.5000	5.3050	0.8475	0.0105	2/.5N
29-52A-6	0.3315	50.0000	600.5000	5.4032	0.8474	0.0105	2/.5N
29-52A-7	0.3513	49.5000	602.0000	5.5570	0.8617	0.0105	2/.5N
29-52A-8	0.2458	50.0000	599.0000	5.2067	0.8816	0.0105	2/.5N
29-52A-9	0.2286	49.5000	601.0000	5.0608	0.8547	0.0105	2/.5N
29-52A-10	0.2002	49.5000	604.0000	4.9616	0.8499	0.0105	2/.5N
29-52A-11	0.3053	50.0000	594.0000	5.3050	0.8865	0.0105	2
29-52A-12	0.2914	49.5000	604.0000	5.3585	0.8566	0.0105	2
29-52A-13	0.2626	49.5000	602.0000	5.5570	0.8700	0.0105	2
29-52A-14	0.2389	49.5000	604.5000	5.2593	0.8683	0.0105	2
29-52A-15	0.2153	49.5000	604.0000	5.2593	0.8655	0.0105	2
29-52A-16	0.1920	49.5000	604.5000	5.1601	0.8590	0.0105	2
29-52A-17	0.3397	49.5000	601.5000	5.5570	0.8580	0.0105	2
29-53A-1	0.0	31.0000	166.5000	15.8452	0.8564	0.0108	2
29-54A-1	0.2653	49.0000	599.5000	4.6113	0.8939	0.0109	2/.5N
29-54A-2	0.2435	49.5000	607.5000	4.3662	0.8871	0.0109	2/.5N
29-54A-3	0.2175	50.0000	605.0000	4.3226	0.8961	0.0109	2/.5N
29-54A-4	0.2148	50.0000	598.0000	4.3226	0.9074	0.0109	2/.5N
29-54A-5	0.2122	50.0000	598.5000	4.1261	0.6757	0.0109	2/.5N
29-54A-6	0.1980	45.5000	606.5000	4.3182	0.8566	0.0109	2/.5N
29-54A-7	0.1802	50.0000	600.0000	3.9296	0.8580	0.0109	2/.5N
29-54A-8	0.1678	50.0000	599.5000	3.8314	0.8639	0.0109	2/.5N
29-55A-1	0.2506	50.0000	607.0000	3.8314	0.7799	0.0166	2/.5N
29-55A-2	0.2085	50.0000	603.0000	3.6349	0.8160	0.0166	2/.5N
29-55A-3	0.1984	50.0000	602.5000	3.4384	0.8067	0.0166	2/.5N
29-55A-4	0.1792	49.5000	606.0000	3.4731	0.8120	0.0166	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-55A-5	0.1499	49.0000	604.5000	3.4083	0.8131	0.0166	2/.5N
29-55A-6	0.2418	50.0000	604.0000	3.3402	0.7509	0.0166	2/.5N
29-55A-7	0.2946	50.0000	607.5000	3.5366	0.7355	0.0166	2/.5N
29-55A-8	0.2206	49.5000	602.0000	3.6716	0.7712	0.0166	2/.5N
29-55A-9	0.1898	50.0000	603.5000	3.4384	0.7660	0.0166	2/.5N
29-55A-10	0.2791	50.0000	608.0000	4.5190	0.6995	0.0166	2/.5N
29-55A-11	0.2408	50.0000	602.5000	4.5190	0.7057	0.0166	2/.5N
29-55A-12	0.2062	49.5000	605.0000	4.3662	0.7047	0.0166	2/.5N
29-55A-13	0.1971	50.0000	608.0000	4.1261	0.6883	0.0166	2/.5N
29-55A-14	0.1801	50.0000	599.5000	3.9296	0.6750	0.0166	2/.5N
29-55A-15	0.1492	50.0000	603.5000	3.9296	0.7212	0.0166	2/.5N
29-55A-16	0.3156	50.0000	606.0000	4.5190	0.6851	0.0166	2/.5N
29-55A-17	0.3402	50.0000	601.0000	4.9120	0.6975	0.0166	2/.5N
29-55A-18	0.2362	50.0000	605.5000	3.5366	0.6143	0.0166	2/.5N
29-55A-19	0.1810	50.0000	600.0000	3.6349	0.6717	0.0166	2/.5N
29-55A-20	0.3923	50.0000	617.0000	4.5190	0.6591	0.0166	2/.5N
29-56A-1	0.4017	49.5000	607.0000	4.6639	0.7533	0.0097	2/.5N
29-56A-2	0.3477	50.0000	607.0000	4.3226	0.7452	0.0097	2/.5N
29-56A-3	0.2852	49.0000	606.0000	4.3105	0.7592	0.0097	2/.5N
29-56A-4	0.2248	49.0000	605.5000	4.3105	0.7564	0.0097	2/.5N
29-56A-5	0.2090	50.0000	601.0000	4.1261	0.7416	0.0097	2/.5N
29-56A-6	0.1953	49.5000	603.0000	4.1678	0.7442	0.0097	2/.5N
29-56A-7	0.2158	49.5000	607.5000	4.1678	0.7409	0.0097	2/.5N
29-56A-8	0.2223	49.5000	602.5000	4.1678	0.7418	0.0097	2/.5N
29-56A-9	0.2760	50.0000	605.5000	4.3226	0.8539	0.0097	2/.5N
29-56A-10	0.2288	50.0000	605.0000	4.1261	0.8524	0.0097	2/.5N
29-56A-11	0.1960	49.5000	603.5000	4.1678	0.8665	0.0097	2/.5N
29-56A-12	0.1768	49.5000	603.5000	4.1678	0.8755	0.0097	2/.5N
29-56A-13	0.1646	49.0000	604.5000	4.2103	0.8817	0.0097	2/.5N
29-56A-14	0.1614	49.0000	603.0000	4.1100	0.8759	0.0097	2/.5N
29-56A-15	0.1533	50.0000	598.5000	4.0278	0.8544	0.0097	2/.5N
29-57A-1	0.3155	50.0000	597.5000	4.2243	0.8572	0.0101	2
29-57A-2	0.3663	50.0000	603.5000	4.4208	0.8530	0.0101	2
29-57A-3	0.3894	50.0000	598.5000	4.5190	0.8566	0.0101	2
29-57A-4	0.3703	49.5000	605.0000	4.5647	0.6663	0.0101	2
29-57A-5	0.3463	49.5000	602.0000	4.4655	0.8777	0.0101	2
29-57A-6	0.3231	50.0000	604.5000	4.4208	0.8675	0.0101	2/.5N
29-57A-7	0.3449	49.0000	600.0000	4.6113	0.8759	0.0101	2/.5N
29-57A-8	0.3741	50.0000	600.5000	4.5190	0.8665	0.0101	2/.5N
29-57A-9	0.3512	50.0000	602.5000	4.5190	0.8603	0.0101	2/.5N
29-57A-10	0.3593	50.0000	603.5000	4.5190	0.8526	0.0101	2/.5N
29-57A-11	0.2812	49.0000	605.0000	4.3105	0.8437	0.0101	2/.5N
29-57A-12	0.2277	50.0000	598.0000	3.9296	0.8565	0.0101	2/.5N
29-57A-13	0.1671	49.5000	602.0000	3.8701	0.8662	0.0101	2/.5N
29-58A-1	0.3876	49.5000	601.0000	4.0685	0.8488	0.0110	2/.5N
29-58A-2	0.3293	50.0000	600.0000	3.8314	0.8518	0.0110	2/.5N
29-58A-3	0.4065	49.5000	600.0000	4.0685	0.8527	0.0110	2/.5N
29-58A-4	0.4306	50.0000	601.5000	4.2243	0.8570	0.0110	2/.5N
29-58A-5	0.4143	50.0000	604.0000	4.2243	0.8576	0.0110	2/.5N
29-58A-6	0.4054	49.5000	604.0000	4.2670	0.8653	0.0110	2/.5N
29-58A-7	0.3105	50.0000	604.0000	4.0278	0.8691	0.0110	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-58A-8	0.3614	50.0000	605.0000	4.1261	0.8633	0.0110	2
29-58A-9	0.3873	50.0000	597.0000	4.1261	0.8600	0.0110	2
29-58A-10	0.4096	49.5000	597.5000	4.2670	0.8645	0.0110	2
29-58A-11	0.4344	49.5000	605.5000	4.4655	0.8630	0.0110	2
29-58A-12	0.4274	50.0000	603.5000	4.2243	0.8474	0.0110	2
29-58A-13	0.4123	49.5000	604.0000	4.4655	0.8684	0.0110	2
29-59A-1	0.3025	50.0000	602.0000	4.8138	0.7847	0.0124	2/.5N
29-59A-2	0.2769	50.0000	605.5000	5.0102	0.7806	0.0124	2/.5N
29-59A-3	0.2474	50.0000	609.0000	5.1085	0.7883	0.0124	2/.5N
29-59A-4	0.2154	50.5000	602.5000	4.9606	0.7879	0.0124	2/.5N
29-59A-5	0.1929	49.5000	600.5000	5.1601	0.8020	0.0124	2/.5N
29-59A-6	0.1833	50.0000	605.5000	5.0102	0.7912	0.0124	2/.5N
29-59A-7	0.2020	50.0000	603.5000	5.1085	0.7894	0.0124	2/.5N
29-59A-8	0.2869	50.0000	602.0000	5.1085	0.7878	0.0124	2
29-59A-9	0.2702	50.0000	604.5000	4.9120	0.7652	0.0124	2
29-59A-10	0.2428	50.0000	604.5000	4.8138	0.7649	0.0124	2
29-59A-11	0.2114	50.0000	602.5000	4.9120	0.7775	0.0124	2
29-59A-12	0.2003	50.0000	602.5000	4.7155	0.7770	0.0124	2
29-59A-13	0.1527	50.0000	602.5000	4.5190	0.7894	0.0124	2
29-60A-1	0.2827	50.0000	604.0000	4.0278	0.7649	0.0134	2/.5N
29-60A-2	0.2446	49.5000	606.0000	4.6639	0.7975	0.0134	2/.5N
29-60A-3	0.2169	50.0000	600.0000	4.3226	0.7826	0.0134	2/.5N
29-60A-4	0.1863	49.5000	601.0000	4.1678	0.7790	0.0134	2/.5N
29-60A-5	0.2075	50.5000	601.5000	4.0852	0.7691	0.0134	2/.5N
29-60A-6	0.2710	50.5000	607.0000	4.1825	0.7632	0.0134	2
29-60A-7	0.2388	49.5000	598.0000	4.2670	0.7785	0.0134	2
29-60A-8	0.2154	50.5000	603.5000	4.0852	0.7638	0.0134	2
29-60A-9	0.1835	50.0000	596.5000	4.3226	0.7777	0.0134	2
29-60A-10	0.1533	50.0000	609.5000	4.6173	0.7865	0.0134	2
29-60A-11	0.1218	50.0000	600.0000	4.3226	0.8065	0.0134	2
29-60A-12	0.2861	50.0000	602.5000	4.7155	0.7962	0.0134	2
29-61A-1	0.3045	50.0000	598.0000	3.5366	0.7096	0.0155	2/.5N
29-61A-2	0.2688	50.0000	599.5000	3.7331	0.7249	0.0155	2/.5N
29-61A-3	0.2346	50.0000	603.0000	3.7331	0.7230	0.0155	2/.5N
29-61A-4	0.2159	50.0000	602.5000	3.8314	0.7385	0.0155	2/.5N
29-61A-5	0.1918	49.0000	597.0000	4.4106	0.7553	0.0155	2/.5N
29-61A-6	0.2486	50.0000	603.0000	4.1261	0.7275	0.0155	2/.5N
29-61A-7	0.2310	50.0000	600.0000	4.1261	0.7333	0.0155	2/.5N
29-61A-8	0.2757	50.0000	598.5000	3.9296	0.7059	0.0155	2/.5N
29-61A-9	0.2548	50.0000	598.0000	4.0278	0.7270	0.0155	2
29-61A-10	0.2199	49.5000	600.5000	4.1678	0.7460	0.0155	2
29-61A-11	0.1889	49.5000	603.0000	4.3662	0.7539	0.0155	2
29-61A-12	0.2370	50.0000	596.5000	4.2243	0.7267	0.0155	2
29-61A-13	0.2946	50.0000	596.5000	3.9296	0.7013	0.0155	2
29-61A-14	0.3004	50.0000	601.0000	3.7331	0.7183	0.0113	2/.5N
29-61A-15	0.2337	50.0000	596.5000	3.5366	0.7250	0.0113	2/.5N
29-61A-16	0.2078	50.0000	599.5000	3.7331	0.7437	0.0113	2/.5N
29-61A-17	0.2446	50.0000	601.0000	3.7331	0.7395	0.0113	2/.5N
29-61A-18	0.2540	50.0000	601.5000	3.7331	0.7303	0.0113	2/.5N
29-61A-19	0.2699	50.0000	601.0000	3.7331	0.7210	0.0113	2/.5N
29-61A-20	0.2397	50.0000	599.5000	3.7331	0.7277	0.0113	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-61A-21	0.2311	50.0000	601.5000	3.7331	0.7325	0.0113	2/.5N
29-61A-22	0.2761	50.0000	600.5000	4.3226	0.7480	0.0113	2
29-61A-23	0.2452	50.0000	597.5000	4.3226	0.7574	0.0113	2
29-61A-24	0.2115	49.0000	598.5000	4.6113	0.7769	0.0113	2
29-61A-25	0.1769	49.0000	596.5000	4.5110	0.7806	0.0113	2
29-61A-26	0.2284	50.0000	595.0000	4.3226	0.7574	0.0113	2
29-61A-27	0.2356	50.0000	593.5000	4.3226	0.7525	0.0113	2
29-62A-1	0.2958	50.0000	601.5000	5.3050	0.6283	0.0130	2
29-62A-2	0.2608	49.5000	608.5000	5.5570	0.6313	0.0130	2
29-62A-3	0.2209	50.0000	604.0000	5.5014	0.6462	0.0130	2
29-63A-1	0.0	50.0000	601.5000	3.9296	0.5900	0.0076	2/.5N
29-64A-1	0.3665	50.0000	599.0000	5.6979	0.6246	0.0087	2
29-64A-2	0.3638	50.0000	604.5000	5.1085	0.5707	0.0087	2
29-64A-3	0.3151	50.0000	603.5000	5.0102	0.5919	0.0087	2
29-64A-4	0.2853	49.5000	605.0000	4.7632	0.5782	0.0087	2
29-64A-5	0.2413	49.5000	602.5000	4.5647	0.5750	0.0087	2
29-64A-6	0.1987	49.5000	603.5000	4.5647	0.5867	0.0087	2
29-65A-1	0.2844	50.0000	603.0000	3.9296	0.7613	0.0139	2/.5N
29-65A-2	0.2809	50.0000	601.5000	3.9296	0.7709	0.0139	2/.5N
29-65A-3	0.2511	50.0000	604.5000	4.0278	0.7776	0.0139	2/.5N
29-65A-4	0.2233	50.0000	603.5000	3.7331	0.7609	0.0139	2/.5N
29-65A-5	0.1842	50.0000	601.0000	3.7331	0.7882	0.0139	2/.5N
29-65A-6	0.1978	50.0000	600.5000	3.7331	0.7830	0.0139	2/.5N
29-65A-7	0.2227	50.5000	600.5000	3.6962	0.7625	0.0139	2/.5N
29-65A-8	0.2301	50.0000	603.0000	3.7331	0.7602	0.0139	2/.5N
29-65A-9	0.2753	50.5000	602.5000	3.8907	0.7511	0.0121	2
29-65A-10	0.2428	50.0000	605.5000	3.9296	0.7661	0.0121	2
29-65A-11	0.2162	50.0000	606.0000	3.7331	0.7609	0.0121	2
29-65A-12	0.1828	50.0000	605.5000	3.7331	0.7813	0.0121	2
29-65A-13	0.2026	50.0000	600.0000	3.7331	0.7697	0.0121	2
29-65A-14	0.2156	50.0000	602.0000	3.7331	0.7633	0.0121	2
29-65A-15	0.2183	50.0000	605.0000	3.7331	0.7530	0.0121	2
29-65A-16	0.2113	50.0000	601.0000	3.7331	0.7548	0.0118	2/.5N
29-65A-17	0.2039	50.0000	597.0000	3.7331	0.7579	0.0118	2/.5N
29-65A-18	0.2263	50.0000	599.5000	3.7331	0.7490	0.0118	2/.5N
29-65A-19	0.2589	50.5000	598.5000	3.8907	0.7525	0.0118	2/.5N
29-65A-20	0.1833	50.0000	603.0000	3.9296	0.7912	0.0118	2/.5N
29-65A-21	0.1984	50.0000	602.5000	3.9296	0.7798	0.0118	2/.5N
29-65A-22	0.1956	50.0000	602.5000	2.7507	0.6210	0.0096	2/.5N
29-65A-24	0.2239	50.5000	604.0000	2.7235	0.6273	0.0096	2/.5N
29-65A-25	0.2469	50.0000	601.0000	2.6525	0.6070	0.0096	2/.5N
29-65A-26	0.1868	50.0000	607.5000	2.7507	0.6001	0.0096	2/.5N
29-65A-26	0.2611	50.6000	594.0000	5.1085	0.8270	0.0093	2/.5N
29-65A-27	0.2331	50.6000	602.5000	4.9120	0.8360	0.0093	2/.5N
29-65A-28	0.1972	49.5000	605.5000	5.1601	0.8600	0.0093	2/.5N
29-65A-29	0.1841	49.0000	604.5000	5.2127	0.8661	0.0093	2/.5N
29-65A-30	0.1689	49.5000	601.5000	4.9616	0.8587	0.0093	2/.5N
29-65A-31	0.1996	50.5000	601.0000	7.0032	0.9761	0.0093	2/.5N
29-65A-32	0.2254	50.5000	600.0000	6.8087	0.9580	0.0093	2/.5N
29-65A-33	0.2440	50.5000	600.0000	6.8087	0.9367	0.0093	2/.5N
29-65A-34	0.1757	49.0000	599.0000	7.3179	0.9648	0.0093	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-65A-35	0.2902	49.5000	610.5000	4.4655	0.7463	0.0157	2/.5N
29-65A-36	0.2649	50.0000	602.5000	4.2243	0.7378	0.0157	2/.5N
29-65A-37	0.2291	49.0000	610.5000	4.1100	0.7422	0.0157	2/.5N
29-65A-38	0.1967	49.5000	600.5000	3.9693	0.7391	0.0157	2/.5N
29-65A-39	0.2173	49.5000	610.5000	3.9693	0.7355	0.0157	2/.5N
29-65A-40	0.2249	50.0000	604.0000	4.9120	0.8066	0.0157	2/.5N
29-65A-41	0.2411	50.0000	604.0000	5.1085	0.8099	0.0157	2/.5N
29-65A-42	0.2031	49.5000	596.5000	5.0608	0.8116	0.0157	2/.5N
29-65A-43	0.1892	49.0000	600.6000	5.1125	0.8187	0.0157	2/.5N
29-66A-1	0.3332	50.0000	599.0000	3.7331	0.8736	0.0141	2
29-66A-2	0.3605	50.5000	607.0000	3.6962	0.8658	0.0141	2
29-66A-3	0.3807	50.0000	603.5000	3.7331	0.8747	0.0141	2
29-66A-4	0.4105	50.0000	609.5000	3.7331	0.8822	0.0141	2
29-66A-5	0.3143	50.5000	602.0000	3.5016	0.8587	0.0141	2
29-66A-6	0.2854	50.0000	600.5000	3.3402	0.8720	0.0141	2
29-66A-7	0.2616	50.0000	604.0000	3.3402	0.8707	0.0141	2
29-66A-8	0.2386	50.5000	598.5000	3.1126	0.8671	0.0141	2
29-66A-9	0.3129	49.5000	604.0000	3.7708	0.8936	0.0131	2/.5N
29-66A-10	0.3418	50.0000	600.0000	3.7331	0.8821	0.0131	2/.5N
29-66A-11	0.3688	50.0000	600.0000	3.7331	0.8775	0.0131	2/.5N
29-66A-12	0.3959	50.0000	600.0000	3.7331	0.8733	0.0131	2/.5N
29-66A-13	0.2921	50.0000	598.5000	3.5366	0.8842	0.0131	2/.5N
29-66A-14	0.2637	50.0000	603.0000	3.5366	0.8985	0.0131	2/.5N
29-67A-1	0.2168	49.7500	606.5000	3.9493	0.9540	0.0156	2/.5N
29-67A-2	0.1946	49.7500	602.5000	3.9493	0.9552	0.0156	2/.5N
29-67A-3	0.1719	49.7500	597.5000	3.7519	0.9571	0.0156	2/.5N
29-67A-4	0.1519	49.7500	605.5000	3.7519	0.9395	0.0156	2/.5N
29-67A-5	0.1277	50.0000	601.0000	3.7331	0.9450	0.0156	2/.5N
29-67A-6	0.1027	50.0000	605.5000	3.7331	0.9567	0.0156	2/.5N
29-67A-7	0.1814	50.0000	598.0000	6.0909	1.1394	0.0156	2/.5N
29-67A-8	0.1637	50.0000	602.5000	6.0909	1.1346	0.0156	2/.5N
29-67A-9	0.1454	50.0000	603.0000	5.8944	1.1307	0.0156	2/.5N
29-67A-10	0.1256	50.0000	597.0000	5.8944	1.1358	0.0156	2/.5N
29-67A-11	0.1044	50.0000	600.0000	5.9926	1.1554	0.0156	2/.5N
29-67A-12	0.2066	50.0000	599.5000	4.0278	0.9421	0.0156	2/.5N
29-67A-13	0.1601	50.0000	607.0000	3.9296	0.9412	0.0156	2/.5N
29-67A-14	0.1517	50.0000	600.5000	4.0278	0.9548	0.0156	2/.5N
29-67A-15	0.1268	50.0000	602.5000	3.9296	0.9574	0.0156	2/.5N
29-67A-16	0.1017	50.0000	599.0000	3.9296	0.9663	0.0156	2/.5N
29-67A-17	0.2115	50.0000	602.0000	3.9296	0.9485	0.0154	2
29-67A-18	0.1907	50.0000	605.5000	3.9296	0.9455	0.0154	2
29-67A-19	0.1678	49.5000	604.5000	3.9693	0.9515	0.0154	2
29-67A-20	0.1770	50.0000	599.5000	3.9296	0.9483	0.0154	2
29-67A-21	0.2317	50.0000	603.5000	4.1261	0.9534	0.0154	2
29-67A-22	0.2283	50.0000	601.0000	3.9296	0.9477	0.0154	2/.5N
29-67A-23	0.2047	49.5000	601.5000	4.0685	0.9533	0.0154	2/.5N
29-67A-24	0.1731	50.0000	598.5000	3.9296	0.9522	0.0154	2/.5N
29-67A-25	0.1452	50.0000	597.0000	4.1261	0.9670	0.0154	2/.5N
29-67A-26	0.1619	50.0000	598.5000	4.1261	0.9565	0.0154	2/.5N
29-67A-27	0.2227	50.0000	598.0000	3.9296	0.9326	0.0154	2/.5N
29-67A-28	0.1966	50.0000	597.0000	4.1261	0.9396	0.0154	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-72A-1	0.3564	49.7500	604.0000	3.6531	0.6224	0.0011	2
29-72A-2	0.2875	49.7500	602.0000	3.3569	0.6293	0.0011	2
29-72A-3	0.2564	49.7500	613.0000	3.2582	0.6244	0.0011	2
29-72A-4	0.2179	49.0000	601.0000	3.2078	0.6371	0.0011	2
29-72A-5	0.1891	49.5000	596.0000	2.7785	0.6210	0.0011	2
29-72A-6	0.1571	50.0000	599.5000	2.6525	0.6088	0.0011	2
29-72A-7	0.1227	49.5000	583.0000	2.3816	0.6060	0.0011	2
29-72A-8	0.0934	49.7500	596.0000	2.1721	0.6171	0.0011	2
29-72A-9	0.2694	49.7500	600.0000	3.3569	0.6331	0.0049	2/.5N
29-72A-10	0.2307	49.5000	610.0000	3.1754	0.6318	0.0049	2/.5N
29-72A-11	0.1886	49.5000	599.5000	3.0762	0.6475	0.0049	2/.5N
29-72A-12	0.1543	49.5000	604.0000	2.9770	0.6405	0.0049	2/.5N
29-72A-13	0.1145	49.5000	596.5000	2.7785	0.6645	0.0049	2/.5N
29-72A-14	0.0834	49.5000	608.0000	2.7785	0.6427	0.0049	2/.5N
29-72A-15	0.0988	49.5000	589.5000	2.6793	0.6334	0.0049	2/.5N
29-73A-1	0.0656	50.0000	601.5000	3.4384	1.4475	0.0083	2
29-73A-2	0.0808	49.7500	595.0000	3.6531	1.4427	0.0083	2
29-73A-3	0.0504	50.2500	593.5000	3.4215	1.4651	0.0083	2
29-73A-4	0.0359	80.0000	601.5000	1.2280	1.4761	0.0083	2
29-73A-5	0.0488	80.5000	600.0000	1.3424	1.5108	0.0083	2
29-73A-6	0.0636	80.0000	598.5000	1.3508	1.4934	0.0083	2
29-73A-7	0.0820	49.5000	606.5000	2.4242	1.0588	0.0119	2
29-73A-8	0.0701	49.7500	601.5000	2.4121	1.0588	0.0119	2
29-73A-9	0.0906	49.5000	606.0000	2.4242	1.0546	0.0119	2
29-73A-10	0.1029	49.7500	603.0000	2.4121	1.0558	0.0119	2
29-73A-11	0.0466	49.0000	604.0000	2.2449	1.0563	0.0119	2
29-73A-12	0.0531	74.5000	603.5000	2.4161	1.7150	0.0123	2
29-73A-13	0.0677	74.2500	606.5000	2.5589	1.7309	0.0123	2
29-73A-14	0.0793	74.2500	602.5000	2.6936	1.7461	0.0123	2
29-73A-15	0.0875	73.7500	601.0000	2.7119	1.7283	0.0123	2
29-73A-16	0.0929	75.0000	603.0000	2.6667	1.7181	0.0123	2
29-73A-17	0.0693	99.2500	597.0000	2.5189	2.3009	0.0123	2
29-73A-18	0.0801	99.2500	600.5000	2.5189	2.2510	0.0123	2
29-73A-19	0.0873	101.0000	599.5000	2.4752	2.2976	0.0123	2
29-73A-20	0.0927	100.0000	601.5000	2.5000	2.2965	0.0123	2
29-73A-21	0.0915	49.2500	792.0000	3.0457	1.0373	0.0123	2
29-73A-22	0.1130	49.7500	810.5000	3.0151	1.0350	0.0123	2
29-73A-23	0.0755	49.5000	802.5000	3.0303	1.0355	0.0123	2
29-74A-1	0.1708	49.5000	599.0000	4.2670	0.6835	0.0092	2
29-74A-2	0.2029	50.0000	604.5000	4.2243	0.6805	0.0092	2
29-74A-3	0.2316	49.5000	602.0000	4.4655	0.6871	0.0092	2
29-74A-4	0.2609	50.0000	603.5000	4.4208	0.6891	0.0092	2
29-74A-5	0.2910	49.5000	603.5000	4.6639	0.6880	0.0092	2
29-74A-6	0.3219	49.7500	601.0000	4.6405	0.6850	0.0092	2
29-74A-7	0.3498	50.0000	601.5000	4.7155	0.6681	0.0092	2
29-74A-8	0.1763	49.2500	601.0000	4.2866	0.6863	0.0092	2/.5N
29-74A-9	0.2104	49.7500	602.5000	4.4430	0.6890	0.0092	2/.5N
29-74A-10	0.2481	49.7500	603.0000	4.4430	0.6834	0.0092	2/.5N
29-74A-11	0.2852	49.7500	604.5000	4.5417	0.6830	0.0092	2/.5N
29-74A-12	0.3180	49.7500	602.5000	4.6405	0.6788	0.0092	2/.5N
29-74A-13	0.3455	49.2500	600.5000	4.8871	0.6858	0.0092	2/.5N

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EGR	PT3	TT3	LPL	AIRFLW	SHX	FUEL
29-75A-1	0.1974	49.9500	601.6000	4.4252	0.5924	0.0208	2
29-75A-2	0.2313	50.0000	603.0000	4.5190	0.5976	0.0208	2
29-75A-3	0.2613	50.0000	604.0000	4.6173	0.6095	0.0208	2
29-75A-4	0.3030	50.0000	601.0000	4.7155	0.5941	0.0208	2
29-75A-5	0.3350	50.0000	605.0000	4.8138	0.5979	0.0208	2
29-75A-6	0.3760	50.0000	605.0000	4.9120	0.5867	0.0208	2
29-75A-7	0.4138	50.0000	602.5000	5.0102	0.5841	0.0208	2
29-75A-8	0.2068	50.0000	604.0000	4.6173	0.5874	0.0215	27.5N
29-75A-9	0.2463	50.0000	604.0000	4.9120	0.5894	0.0215	27.5N
29-75A-10	0.2876	50.2500	601.0000	5.0831	0.5903	0.0215	27.5N
29-75A-11	0.3284	50.2500	601.0000	5.1808	0.5936	0.0215	27.5N
29-75A-12	0.2662	50.0000	597.0000	5.2067	0.5996	0.0215	27.5N
29-75A-13	0.2298	50.0000	600.0000	5.2067	0.5961	0.0215	27.5N
29-75A-14	0.1645	50.0000	604.0000	5.4032	0.5976	0.0215	27.5N
29-76A-1	0.0952	49.5000	604.0000	2.2823	1.1336	0.0094	2
29-76A-2	0.0838	49.7500	604.5000	2.1721	1.1327	0.0094	2
29-76A-3	0.0724	49.7500	598.0000	2.1721	1.1328	0.0094	2
29-76A-4	0.0541	49.5000	602.0000	2.1831	1.1324	0.0094	2
29-76A-5	0.0548	98.0000	604.0000	1.4034	1.9692	0.0094	2
29-76A-6	0.0696	100.0000	597.0000	1.3754	1.9807	0.0094	2
29-76A-7	0.0852	98.5000	600.0000	1.2966	1.6647	0.0094	2
29-76A-8	0.0747	49.5000	601.0000	4.7632	1.6741	0.0088	2
29-76A-9	0.0647	50.5000	602.0000	4.6688	1.6695	0.0088	2
29-76A-10	0.0515	49.5000	598.0000	4.7632	1.6743	0.0088	2
29-76A-11	0.0442	49.5000	601.0000	4.6639	1.6703	0.0088	2
29-76A-12	0.0515	49.2500	599.5000	6.5626	1.9279	0.0088	2
29-76A-13	0.0629	48.5000	604.0000	6.4818	1.8543	0.0088	2
29-76A-14	0.0702	50.0000	594.0000	5.8944	1.8427	0.0088	2
29-76A-15	0.0359	50.2500	402.0000	4.3988	2.0532	0.0088	2
29-76A-16	0.0493	53.5000	397.0000	4.2234	1.9278	0.0088	2
29-76A-17	0.0599	49.2500	403.0000	4.5879	1.8745	0.0088	2
29-76A-18	0.0669	49.2500	398.0000	4.5679	1.8714	0.0088	2
29-77A-1	0.1394	49.5000	597.5000	4.3662	0.6796	0.0099	2
29-77A-2	0.1718	49.5000	598.5000	4.3662	0.6775	0.0099	2
29-77A-3	0.2354	50.0000	601.5000	4.5190	0.6740	0.0099	2
29-77A-4	0.2948	50.0000	602.5000	4.7155	0.6772	0.0099	2
29-77A-5	0.3545	49.5000	599.0000	4.9616	0.6778	0.0099	2
29-77A-6	0.4149	49.5000	604.5000	5.1601	0.6766	0.0099	2
29-77A-7	0.4453	49.5000	604.5000	5.2593	0.6760	0.0099	2
29-77A-8	0.4746	49.5000	602.0000	5.3585	0.6769	0.0099	2
29-77A-9	0.5054	49.5000	602.5000	5.2593	0.6758	0.0099	2
29-77A-10	0.3504	50.0000	603.0000	4.7155	0.6747	0.0099	27.5N
29-77A-11	0.4084	50.0000	600.0000	4.9120	0.6840	0.0099	27.5N
29-77A-12	0.4355	50.0000	603.5000	5.4032	0.6913	0.0099	27.5N
29-77A-13	0.4658	50.0000	606.0000	5.5997	0.6938	0.0099	27.5N
29-77A-14	0.4454	49.0000	602.0000	5.7140	0.6959	0.0099	27.5N
29-77A-15	0.5404	49.5000	603.0000	5.5570	0.6802	0.0099	27.5N
29-77A-16	0.2973	49.7500	600.0000	5.1341	0.6045	0.0092	2
29-77A-17	0.3355	50.2500	605.0000	4.1056	0.5958	0.0092	2
29-77A-18	0.2307	49.7500	597.0000	4.4430	0.6667	0.0092	2
29-77A-19	0.2790	50.2500	603.0000	4.4966	0.6619	0.0092	2

TABLE A-1
COMBUSTOR OPERATOR PARAMETER DATA (Continued)

SCHEME	EQR	PT3	TT3	LPL	AIRFLW	SMX	FUEL
29-77A-20	0.3017	49.7500	602.6000	4.7392	0.8643	0.0092	2
29-77A-21	0.3243	49.7500	604.0000	4.9367	0.8664	0.0092	2
29-77A-22	0.3474	50.0000	596.5000	4.8138	0.8673	0.0092	2
29-77A-23	0.3131	50.0000	600.0000	4.5190	0.8585	0.0092	2
29-77A-24	0.2084	50.0000	601.5000	4.3226	0.8617	0.0092	2
29-77A-25	0.1606	49.7500	598.0000	4.2455	0.8579	0.0092	2
29-77A-26	0.1099	49.7500	604.0000	4.1468	0.8637	0.0092	2
29-77A-27	0.3975	50.0000	605.0000	4.9120	0.8587	0.0092	2
29-77A-28	0.4224	50.0000	606.0000	4.9120	0.8564	0.0092	2
29-77A-29	0.3741	50.0000	598.5000	4.7155	0.8593	0.0092	2
29-77A-30	0.0	50.0000	604.5000	3.8000	0.8864	0.0090	2
29-77A-31	0.0	50.0000	597.0000	6.6000	1.0609	0.0090	2
29-77A-32	0.0	50.0000	600.5000	8.0000	1.2055	0.0090	2
29-77A-33	0.0	50.0000	604.5000	3.4000	0.8481	0.0090	2

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA

SCHEME	EGR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
01-05A-1	0.0845	26.9592	38.2923	194.2361	1.1830	18.3236	99.8649	0.9806	
01-05A-2	0.1247	44.1004	29.6552	186.4252	1.6951	18.2619	99.8173	0.9548	
01-05A-3	0.1750	5.1847	34.3739	170.2024	2.2567	17.1132	99.9419	0.9079	
01-05A-4	0.1858	2.5720	28.6266	167.2875	2.4694	16.8272	99.9574	0.9361	
01-05A-5	0.1415	9.4768	45.7911	153.6074	1.8884	17.3647	99.9141	0.9377	
01-05A-6	0.1095	10.7549	29.5306	162.7623	1.6377	17.9329	99.9292	1.0480	
01-06A-1	0.1123	23.2586	34.8417	200.7750	1.5369	17.9499	99.8811	0.9601	
01-06A-2	0.1456	2.8339	26.8620	183.4824	1.9483	17.1883	99.9587	0.9398	
01-06A-3	0.1780	1.7358	28.4543	180.1573	2.3363	16.5665	99.9604	0.9239	
01-07A-1	0.1798	16.0659	50.0447	158.3227	2.4473	17.2484	99.8867	0.9591	
01-07A-2	0.2252	13.3252	37.9040	172.7567	3.0821	16.4486	99.9100	0.9671	
01-07A-3	0.1463	9.2981	37.7700	139.2792	2.0216	17.8897	99.9242	0.9708	
01-07A-4	0.2786	9.9690	16.5230	168.7750	3.7567	13.3691	99.9466	0.9555	
01-07A-5	0.3397	5.5899	11.5144	160.3444	4.6852	13.7449	99.9672	0.9812	
01-07A-6	0.3896	3.3556	8.8570	149.6742	5.3978	12.7174	99.9779	0.9869	
01-07A-7	0.2264	3.2055	15.2422	174.4202	3.2029	15.4717	99.9711	0.9989	
01-07A-8	0.1779	3.1975	19.3971	169.7558	2.4667	16.9082	99.9663	0.9759	
01-07A-9	0.1206	7.3272	220.2920	127.4526	1.8443	17.9098	99.7155	1.0775	
01-07A-10	0.3971	0.5180	7.5302	120.3937	5.7519	12.5005	99.9892	1.0344	
01-07A-11	0.1922	0.5342	22.7539	128.8399	2.6668	16.7263	99.9712	0.9783	
01-07A-12	0.1431	6.0264	53.1241	220.5191	2.0956	17.7177	99.9170	1.0289	
01-07A-13	0.1766	1.9931	18.2179	227.1570	2.5696	16.9799	99.9717	1.0238	
01-07A-14	0.2291	1.0958	13.0418	209.6138	3.2346	16.0051	99.9808	0.9971	
01-07A-15	0.2749	0.5470	10.0324	208.8040	3.9820	15.9257	99.9862	1.0261	
01-07A-16	0.3283	0.3050	6.9968	199.7333	4.6311	18.5370	99.9906	1.0025	
01-07A-17	0.3756	0.2666	5.5033	186.0726	5.5899	13.3131	99.9925	1.0610	
01-07A-18	0.1489	1.3478	41.7613	212.9617	2.1469	17.5580	99.9461	1.0136	
01-07A-19	0.2400	0.8359	9.5709	208.9947	3.7344	13.8657	99.9858	1.0993	
01-07A-20	0.3243	0.6166	5.6656	167.0455	4.8247	13.9250	99.9911	1.0571	
01-07A-21	0.3611	0.6952	6.3625	161.7650	5.6092	16.8803	99.9900	1.1066	
01-07A-22	0.1690	1.1875	13.5971	272.9587	2.7590	16.6215	99.9799	1.1484	
01-08A-1	0.1204	2.7764	23.0646	227.9251	1.6691	17.7124	99.9635	0.9723	
01-08A-2	0.1752	0.9520	22.4536	199.9681	2.3943	16.6826	99.9702	0.9615	
01-08A-3	0.2284	0.5597	17.2246	149.6158	3.1135	15.5572	99.9776	0.9625	
01-08A-4	0.2829	0.4322	25.4036	130.4601	3.9005	14.3774	99.9682	0.9774	
01-08A-5	0.3367	0.3466	8.2440	136.1227	4.7091	13.4419	99.9889	0.9946	
01-08A-6	0.2295	0.2421	15.1271	156.7811	3.1610	15.3568	99.9812	0.9728	
01-08A-7	0.2430	0.4575	30.5371	172.5430	3.1241	10.4448	99.9621	0.9092	
01-08A-8	0.2997	0.1854	11.5831	134.4372	3.9289	11.1886	99.9855	0.9302	
01-08A-9	0.3538	0.1885	6.5370	119.1260	4.6970	11.6611	99.9915	0.9452	
01-08A-10	0.1833	1.2143	67.2242	250.6007	2.3748	16.2197	99.9162	0.9135	
01-08A-11	0.2376	0.0234	29.2674	173.3653	3.1346	15.1714	99.9651	0.9324	
01-08A-12	0.2953	0.2446	10.9611	136.4216	3.9318	14.0234	99.9861	0.9443	
01-08A-13	0.3491	0.1751	5.9527	126.0812	4.6541	13.0520	99.9923	0.9488	
01-08A-14	0.3938	0.1976	6.4521	117.2315	5.2387	12.2334	99.9916	0.9497	
01-08A-15	0.4069	0.1639	6.2440	114.7489	5.3714	12.0947	99.9919	0.9432	
01-08A-16	0.3355	0.2485	8.2631	125.4318	4.6066	11.6517	99.9893	0.9765	
01-08A-17	0.1733	0.3206	22.6716	199.1253	2.3424	16.1593	99.9721	0.9510	
01-09A-1	0.0934	7.6072	22.1871	104.6478	1.3652	18.6300	99.9484	1.0231	
01-09A-2	0.1477	2.5815	34.3635	168.6048	2.0623	17.5581	99.9507	0.9809	
01-09A-3	0.2029	1.0722	26.2485	141.7905	2.8486	16.5033	99.9652	0.9828	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EGR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
01-09A-4	0.2580	0.4845	16.0664	136.6951	3.5973	15.4840	99.9792	0.9864	
01-09A-5	0.3121	0.4181	9.6161	123.9230	4.4065	14.3020	99.9871	1.0026	
01-09A-6	0.3643	0.1491	7.5913	112.3696	5.1399	13.2392	99.9904	1.0052	
01-09A-7	0.1195	1.3648	23.2066	213.5242	1.6863	17.9443	99.9680	0.9891	
01-09A-8	0.1060	7.2217	21.7694	172.5821	1.4775	18.2364	99.9502	0.9764	
01-09A-9	0.1204	2.7146	21.0917	218.2354	1.6362	17.9547	99.9660	0.9531	
01-09A-10	0.1734	0.6270	27.9902	142.5126	2.4093	16.8302	99.9647	0.9780	
01-09A-11	0.1116	1.4623	22.7408	267.6484	1.6945	17.8340	99.9683	1.0643	
01-09A-12	0.2521	0.0216	10.9785	135.5493	3.8586	14.7871	99.9868	1.0824	
01-09A-13	0.3109	0.0524	8.1539	116.6232	4.5816	13.8567	99.9901	1.0462	
01-09A-14	0.3705	0.0586	8.0817	107.0785	5.4131	12.7596	99.9901	1.0413	
01-09A-15	0.1965	0.1382	27.0498	129.5204	2.6556	16.3694	99.9674	0.9525	
01-09A-16	0.3021	0.0180	9.1607	116.6697	4.1482	14.2543	99.9890	0.9742	
01-10A-1	0.1207	2.6205	56.4188	102.5431	1.7195	17.9518	99.9246	0.9997	
01-10A-2	0.1753	1.2013	37.4854	93.0938	2.4493	16.9163	99.9516	0.9838	
01-10A-3	0.2297	0.6870	26.5930	96.3920	3.2295	15.8248	99.9661	0.9933	
01-10A-4	0.2836	0.4077	15.7255	103.6635	3.9768	14.6554	99.9798	0.9938	
01-10A-5	0.3344	0.3301	14.7250	100.8122	4.7063	13.7743	99.9812	1.0010	
01-10A-6	0.3636	0.1445	13.5426	103.9520	5.0982	13.1146	99.9833	0.9992	
01-10A-7	0.1211	3.9282	64.0384	130.5347	1.7131	17.7950	99.9113	0.9933	
01-10B-8	0.3406	0.6182	13.0966	145.7160	4.7823	13.6069	99.9822	0.9991	
02-01A-1	0.4672	0.5077	7.4319	172.5532	6.1346	11.0304	99.9863	-	1
02-01B-1	0.3875	0.1357	4.9420	2.0392	5.0419	12.8742	100.0000	-	1
02-01B-2	0.3469	0.0757	4.5120	1.1407	4.4956	13.6676	100.0000	-	1
02-01B-3	0.4062	0.0	4.2830	1.7535	5.2948	12.2241	100.0000	-	1
02-01B-4	0.2627	0.1000	122.7413	0.9071	3.9093	14.6755	99.8551	1.2031	2
02-01B-5	0.2360	0.0	29.7864	1.0099	3.3022	15.5019	99.9650	1.1272	
02-01B-6	0.3624	0.1451	6.6897	0.2194	4.2455	14.3140	99.9916	0.9506	
02-01B-7	0.1753	40.9874	1886.0195	5.8664	2.5049	16.2985	97.6283	1.0529	
02-01B-8	0.1956	15.2374	958.4045	8.4752	2.8472	15.7553	98.8120	1.0494	
02-01B-9	0.1669	12.1325	3383.1426	6.6077	2.5877	15.5263	95.9543	1.1736	4
02-01B-10	0.1618	143.6034	5964.4531	5.3725	2.1813	15.7049	92.4597	1.0987	4
02-01B-11	0.1295	0.0	5603.2461	106.3130	1.8522	16.2168	93.3837	1.1411	4
02-01B-12	0.2699	26.8474	100.9959	147.8661	4.0788	14.6125	99.7888	1.0729	
02-01B-13	0.2468	8.5448	1497.4001	86.3970	3.3373	15.4955	98.1889	0.9932	
02-01B-14	0.2512	5.2171	1755.1824	78.8568	3.1857	15.5757	97.8927	0.9403	
03-03A-1	0.0819	1294.6462	4816.1836	30.3199	1.1696	18.4593	90.0095	1.1484	3 4 5
03-03A-2	0.0989	292.4114	2501.8853	88.8939	1.5762	17.9954	96.0746	1.1844	3 5
03-03A-3	0.1129	54.8130	916.5476	154.6901	1.8921	17.5331	98.7356	1.1973	3 5
03-03A-4	0.1272	17.6495	187.7081	241.0770	2.1658	16.9821	99.7193	1.1982	3 5
03-03A-5	0.0989	176.0198	2322.9521	106.8535	1.6155	17.7010	96.6745	1.2046	3 5
03-04A-1	0.0567	335.9041	3106.9790	36.6981	1.0009	18.6763	95.2301	1.3158	3 5
03-04A-2	0.0737	47.2430	333.3562	39.4832	1.3034	18.2120	99.4502	1.2442	3 5
03-04A-3	0.0849	5.7484	169.0583	60.3936	1.5119	17.7010	99.7818	1.2485	3
03-04A-4	0.0993	4.3017	42.3861	98.0088	1.7059	17.4638	99.9357	1.2030	3
03-04A-5	0.1130	3.2390	26.1494	153.9035	1.8507	17.1209	99.9583	1.1472	3
03-04A-6	0.1273	2.3971	25.2859	218.4893	2.0824	16.7246	99.9621	1.1476	3
03-05A-1	0.0991	0.0	5108.5273	10.5645	0.7522	18.9248	93.9804	0.6568	3 4
03-05A-2	0.1127	0.0	5014.3008	13.2676	1.1053	18.3326	94.0860	0.8106	3 4
03-05A-3	0.1266	0.0	167.0900	23.5388	2.3034	17.2673	99.8027	1.1131	
03-05A-4	0.1402	34.9414	76.6550	74.5897	2.1506	16.8844	99.7923	1.0789	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
03-06A-1	0.0847	125.4901	1505.9062	46.2380	1.3944	18.1954	97.8082	1.1906	6
03-06A-2	0.0533	0.0	6954.0469	65.3041	0.6918	18.9464	91.8314	1.0768	6
03-06A-3	0.0730	0.0	1879.9417	110.7931	1.1997	18.3184	97.7887	1.1938	6
03-06A-4	0.0843	71.9043	663.7998	129.4361	1.3716	18.0453	98.9785	1.1550	6
03-06A-5	0.0984	30.4498	81.1179	192.6484	1.6062	17.7003	99.8026	1.1451	6
03-06A-6	0.1124	19.3253	47.0420	298.2874	1.8050	17.3710	99.8799	1.1264	6
03-06A-7	0.0559	0.0	6162.6289	100.2525	0.7090	18.7540	92.7597	1.0358	6
04-01A-1	0.1030	0.0	0.0	0.0	0.0	0.0	-	-	
04-01A-2	0.2611	0.0	0.0	0.0	0.0	0.0	-	-	
04-01A-3	0.2659	0.0	0.0	0.0	0.0	0.0	-	-	
04-01A-4	0.1101	0.0	0.0	0.0	0.0	0.0	-	-	
04-02A-1	0.1281	0.0	0.0	0.0	0.0	0.0	-	-	
04-02A-2	0.3612	0.0	0.0	0.0	0.0	0.0	-	-	
04-02A-3	0.3253	0.0	0.0	0.0	0.0	0.0	-	-	
04-02A-4	0.3672	0.0	0.0	0.0	0.0	0.0	-	-	
04-02A-5	0.1487	0.0	0.0	0.0	0.0	0.0	-	-	
04-03A-1	0.0648	0.0	0.0	0.0	0.0	0.0	-	-	
04-03A-2	0.2291	0.0	0.0	0.0	0.0	0.0	-	-	
04-03A-3	0.1567	0.0	0.0	0.0	0.0	0.0	-	-	
04-03A-4	0.2113	0.0	0.0	0.0	0.0	0.0	-	-	
04-04A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-04A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-04A-3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-4	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-5	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-8	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-9	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-10	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-11	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-12	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-13	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-14	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-15	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-16	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-17	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-18	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-19	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-20	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-21	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-22	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-23	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-24	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-25	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-26	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-27	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-28	0.0	0.0	0.0	0.0	0.0	0.0	-	-	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
04-05A-29	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-30	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-31	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-32	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-33	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-05A-34	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-4	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-5	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-6	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-7	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-8	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-9	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-10	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-11	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-06A-12	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-07A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-07A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-07A-3	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-07A-4	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
04-07A-5	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
05-01A-1	0.1521	165.1151	82.9329	84.6953	1.9001	10.1027	99.3481	0.8833	3
05-01A-2	0.2189	54.7521	39.5335	51.8311	1.7255	11.3691	99.7685	0.5583	3
05-01A-3	0.2641	31.3351	63.3178	62.7283	2.2908	9.7136	99.8186	0.6160	3
05-01A-4	0.3252	30.7118	241.6073	49.1033	2.5023	18.2271	99.6067	0.5534	3
05-01A-5	0.3808	19.4848	200.4634	42.7388	2.4672	16.0529	99.6929	0.4675	3
05-01A-6	0.3736	12.9857	189.7301	47.6591	2.6735	16.4729	99.7280	0.5151	3
05-01A-7	0.3226	17.6913	131.3101	41.8946	2.0125	20.0315	99.7829	0.4468	3
05-01A-8	0.3753	10.6470	161.0806	46.6451	2.5738	18.4791	99.7703	0.4932	3
05-01A-9	0.3162	17.1484	104.3017	38.8448	1.9134	19.1868	99.8171	0.4327	3
05-01A-10	0.2653	13.9858	43.7162	16.8133	1.5197	21.2410	99.9006	0.4068	3
05-02A-1	0.1644	0.0	0.0	0.0	0.0	0.0	-	-	
05-02A-2	0.3654	0.0	0.0	0.0	0.0	0.0	-	-	
05-02A-3	0.3963	0.0	0.0	0.0	0.0	0.0	-	-	
05-02A-4	0.8092	0.0	0.0	0.0	0.0	0.0	-	-	
05-03A-1	0.1602	0.0	0.0	0.0	0.0	0.0	-	-	
05-03A-3	0.3111	0.0	0.0	0.0	0.0	0.0	-	-	
05-03A-3	0.4208	0.0	0.0	0.0	0.0	0.0	-	-	
05-04A-1	0.1698	10.9805	344.4773	152.8840	2.3695	16.8084	99.5552	0.9900	
05-04A-2	0.2475	4.7503	37.2025	66.4688	3.6992	16.8317	99.9397	1.0572	
05-04A-3	0.3061	2.7176	18.7882	138.7816	4.3805	15.7939	99.9683	1.0161	
05-04A-4	0.2920	2.8489	0.0	139.4867	4.2438	15.3430	99.9903	1.0305	
05-04A-5	0.2128	1.7518	117.3788	134.4212	2.6439	16.9137	99.8547	0.8788	
05-04A-6	0.2351	1.8297	4.5397	108.6884	2.6178	17.3584	99.9884	0.7864	7
05-04A-7	0.2701	1.1683	0.0	109.1430	3.3172	16.8502	99.9960	0.8695	
05-04A-8	0.2819	1.0173	0.0	120.4987	3.9466	16.3133	99.9966	0.9917	
05-04A-9	0.3111	0.5532	0.0	126.2557	4.1866	16.5964	99.9981	0.9553	
05-05A-1	0.2408	2.3834	25.2274	159.9817	3.7088	14.4028	99.9619	1.0888	
05-05A-2	0.2190	1.3109	25.7986	131.0290	2.9941	13.0560	99.9649	0.9652	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	COC1	OXQ1	EFFGA	CFRAC	NOTE
05-05A-3	0.1884	4.5684	25.6347	74.9372	2.5471	16.2859	99.9542	0.9523	
05-05A-4	0.1383	360.4429	1296.6787	14.2076	1.3958	18.0914	97.2600	0.7492	
05-05A-5	0.1631	29.9037	36.0313	87.4514	2.1592	16.1595	99.8570	0.9317	
05-05A-6	0.2772	5.1762	19.3622	143.2680	4.7638	11.3750	99.9594	1.2179	8
05-05A-7	0.1884	3.0459	29.8147	237.6257	2.7647	15.4149	99.9544	1.0337	
05-05A-8	0.2469	2.3248	25.2715	235.9808	3.6431	14.0695	99.9621	1.0436	
05-05A-9	0.2771	2.0712	15.7827	229.7688	3.6009	13.5756	99.9742	0.9208	
05-05B-1	0.0560	50.9494	198.3281	48.8725	0.2506	20.5326	99.5972	0.3185	9
05-05B-2	0.0691	24.7749	85.7159	138.7640	0.5432	20.9135	99.8166	0.5519	9
05-05B-3	0.0477	119.6733	203.9975	97.3455	0.2526	21.0228	99.3619	0.3775	9
05-05B-4	0.0550	36.2784	96.1703	132.2750	0.3859	20.8198	99.7661	0.4925	9
05-05B-5	0.0697	24.5631	59.7370	129.3309	0.4943	19.9796	99.8478	0.4976	9
05-05B-6	0.0756	18.8510	36.6358	138.2479	0.7013	19.2481	99.6940	0.6491	9
05-05B-7	0.0470	30.3311	113.2848	163.2527	0.4101	19.9045	99.7660	0.6117	9
05-05B-8	0.0551	25.8673	76.8546	169.6230	0.5119	20.1382	99.8235	0.6503	9
05-05B-9	0.0691	16.5024	43.4864	104.4167	0.7063	19.6762	99.8938	0.7150	9
05-05C-1	0.1411	7.9660	189.7278	76.9628	2.0740	18.8999	99.7491	1.0366	9
05-05C-2	0.1963	5.7227	186.2107	80.3436	2.1374	19.4954	99.7599	0.7715	9
05-05C-3	0.2526	0.7418	21.7614	125.7769	2.9214	17.6482	99.9716	0.8181	9
05-05C-4	0.2280	0.7046	25.5346	109.9793	2.8776	19.3216	99.9673	0.8915	9
05-05C-5	0.2800	0.6692	18.7287	130.4502	3.3081	16.7565	99.9754	0.8372	9
05-05C-6	0.2932	1.0046	20.1411	150.7072	3.6422	15.8043	99.9725	0.8813	9
05-05C-7	0.2609	1.0261	25.7374	162.7468	3.1566	16.4996	99.9659	0.8565	9
05-05C-8	0.2420	0.9955	45.1842	175.6161	2.8002	15.7065	99.9429	0.8185	9
05-05C-9	0.2041	0.9184	20.5208	123.2759	2.3505	16.3636	99.9725	0.8123	9
05-05C-10	0.1990	9.1545	24.4609	151.2576	1.3673	19.3599	99.9402	0.4849	9
05-05C-11	0.2450	5.0286	9.8623	195.3996	1.4810	18.8192	99.9713	0.4276	9
05-05C-12	0.2760	3.2993	11.0747	227.9109	1.5786	18.3833	99.9756	0.4055	9
05-05C-13	0.3071	2.5287	14.5868	272.6543	2.2102	18.6991	99.9740	0.5112	9
05-05C-14	0.3153	2.2077	15.2501	131.7293	1.7405	17.6583	99.9743	0.3923	9
05-06A-1	0.1578	18.6036	134.1563	142.0662	1.3545	17.8403	99.7809	0.6069	9
05-06A-2	0.1874	6.0622	131.2580	152.3390	1.8998	16.9312	99.8240	0.7169	9
05-06A-3	0.1871	15.1803	139.3602	130.8904	1.5986	17.9893	99.7838	0.6052	9
05-06A-4	0.2210	15.4239	265.7761	137.4377	2.0560	17.4760	99.6322	0.6634	9
05-07A-1	0.2154	2.7288	45.5814	164.6653	2.8748	16.8646	99.9367	0.9424	
05-07A-2	0.3103	1.0824	14.2794	151.1252	3.9888	15.0245	99.9792	0.9127	
05-07A-3	0.0445	949.0085	1530.7617	46.4647	0.3135	19.6114	95.0429	0.5521	3
05-07A-4	0.3084	2.9952	10.7357	165.8747	3.7656	15.0992	99.9770	0.8668	
05-07A-5	0.3104	1.8938	9.6052	208.6058	3.8427	14.5965	99.9821	0.8790	
05-07A-6	0.3358	1.5006	6.4040	130.6168	4.1689	14.0865	99.9872	0.8829	
05-07A-7	0.2417	1.4373	30.2217	153.0337	2.0611	16.2631	99.9582	0.7787	
05-07A-8	0.3171	1.5890	7.4459	143.1380	3.9145	14.4474	99.9857	0.8769	
05-07A-9	0.2898	1.6419	7.3880	162.9429	3.7731	14.8485	99.9856	0.9230	
05-07A-10	0.2185	1.7933	34.6944	166.4676	2.7312	16.2204	99.9527	0.8825	
05-07A-11	0.1878	2.0870	24.7982	116.0445	2.1423	16.9717	99.9636	0.8037	
05-07A-12	0.1564	3.0428	17.4501	87.8275	1.6613	17.6550	99.9691	0.7467	
05-07A-13	0.1289	4.5594	20.9257	74.8580	1.3295	18.0224	99.9600	0.7236	
05-07A-14	0.0299	39.8795	821.5564	47.5188	0.4225	19.8585	98.9038	1.0064	
05-07A-15	0.0157	695.6853	977.9578	53.0181	0.2061	19.8660	96.5422	0.9520	
05-08A-1	0.0151	161.8710	0.0	132.5676	0.0	0.0	99.4621	0.0040	
05-09A-1	0.0106	86.1698	147.0149	398.5605	0.1716	19.8992	99.5415	1.1290	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EGR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-09A-2	0.1841	5.1297	118.8640	215.1020	2.5444	16.8481	99.8419	0.9759	
05-09A-3	0.1917	4.1808	54.9270	261.8601	2.6249	16.4233	99.9208	0.9653	
05-09A-4	0.2191	3.1377	45.7756	192.4625	2.9535	15.6793	99.9350	0.9521	
05-09A-5	0.2855	1.9076	29.3799	133.6849	3.3802	15.4846	99.9585	0.8397	9
05-09A-6	0.3287	1.6570	17.1811	111.3835	4.1215	14.2774	99.9738	0.8916	9
05-09A-7	0.3203	0.6959	12.0877	163.9523	4.0677	14.2431	99.9825	0.9023	9
05-09A-8	0.2912	0.5916	22.4681	174.4015	3.5785	15.0881	99.9712	0.8716	9
05-09A-9	0.2297	0.8751	77.3659	170.5612	2.5781	16.3821	99.9051	0.7944	9
05-09A-10	0.2046	1.1222	70.7987	153.7962	2.1814	17.0706	99.9122	0.7530	9
05-09A-11	0.1324	2.8171	80.7808	104.9725	1.1482	18.6020	99.8952	0.6103	9
05-09A-12	0.1265	5.6872	156.3353	96.3022	1.0333	18.6865	99.7957	0.5767	9
05-09A-13	0.1439	6.9580	214.2528	128.3457	1.2892	18.3358	99.7234	0.6343	9
05-10A-1	0.1271	11.5759	368.9456	188.4299	1.6657	0.0	99.5020	0.9285	10
05-10A-2	0.1600	4.6651	212.2027	110.0271	1.5140	16.8139	99.7332	0.6702	10
05-10A-3	0.2102	1.0118	91.2682	121.6265	2.6893	16.0993	99.8882	0.9043	10
05-10A-4	0.2684	0.6932	24.5583	185.7750	3.2507	15.5885	99.9684	0.8577	10
05-10A-5	0.2348	0.5659	63.9294	119.7742	2.7904	15.9129	99.9221	0.8407	10
05-10B-1	0.0140	87.5642	24.7034	150.8755	0.2172	19.9408	99.6801	1.0789	
05-10B-2	0.0174	61.4120	30.3291	139.3514	0.2779	19.8900	99.7603	1.1142	
05-10B-3	0.0202	79.6828	34.9536	150.4825	0.2866	19.7826	99.6941	0.9923	
05-10B-4	0.0254	38.8903	75.6352	144.6372	0.3406	19.4494	99.7820	0.9365	
05-10B-5	0.0313	28.1010	119.8608	116.2961	0.4396	19.6437	99.7659	0.9810	
05-10B-6	0.0379	22.5307	131.3405	106.6041	0.4857	19.4714	99.7709	0.8971	
05-10B-7	0.0438	12.1539	144.5660	108.0577	0.5292	19.6131	99.7898	0.8457	3
05-10B-8	0.0487	19.7157	155.7344	81.6573	0.6270	19.3273	99.7514	0.9015	
05-11A-1	0.0224	34.2395	71.0129	63.2108	0.2311	19.8998	99.8029	0.7210	3
05-11A-2	0.0252	24.2949	77.8310	53.6777	0.2416	20.0691	99.8280	0.6694	3
05-11A-3	0.0135	129.0934	104.6582	136.0134	0.2068	19.9485	99.4484	1.0680	
05-11A-4	0.0167	82.5526	247.0562	97.9760	0.2238	19.8257	99.4362	0.9434	
05-11A-5	0.0193	62.8439	353.3838	87.5118	0.2648	19.7033	99.3770	0.9635	
05-11A-6	0.0221	51.3327	364.0911	90.1301	0.3044	19.8164	99.4026	0.9682	
05-11A-7	0.1165	8.6014	115.5958	114.9307	1.6824	17.7423	99.8348	1.0143	
05-11A-8	0.1857	4.1149	55.7103	199.1998	2.6479	16.5697	99.9201	1.0052	
05-11A-9	0.2379	2.5446	29.5905	147.2827	3.3431	15.4816	99.9562	0.9932	
05-11A-10	0.0169	31.2254	227.5130	69.1016	0.2654	19.4181	99.6296	1.0968	
05-11A-11	0.1138	3.4834	130.2912	116.1204	1.7294	17.6848	99.8347	1.0679	
05-11A-12	0.1121	2.5925	91.5687	113.4368	1.6857	17.3081	99.8833	1.0559	
05-11B-1	0.0166	17.3691	291.7017	74.0147	0.2688	18.9743	99.6005	1.1312	
05-11B-2	0.2915	0.6306	11.2968	177.7184	4.2321	14.3073	99.9844	1.0295	
05-11B-3	0.3191	0.7409	8.1769	182.2630	4.5977	13.7942	99.9877	1.0236	
05-11B-4	0.2421	0.8678	26.3728	148.0924	3.4977	15.2534	99.9657	1.0213	
05-11B-5	0.1830	1.0042	67.9032	155.5807	2.6649	16.3904	99.9162	1.0262	
05-11B-6	0.1583	1.3273	105.2602	163.2878	2.3298	16.7355	99.8710	1.0365	
05-11B-7	0.1170	9.4773	346.4648	122.3980	1.7344	17.5764	99.5595	1.0474	
05-11B-8	0.1358	1.7402	48.1651	139.6421	2.0198	17.2122	99.9373	1.0441	
05-11C-1	0.1357	2.5491	75.6196	173.4352	1.9923	17.2825	99.9021	1.0318	
05-11C-2	0.0675	28.8981	836.6436	77.4683	1.0829	18.6006	98.9199	1.1406	
05-11C-3	0.1200	0.2215	55.9011	160.9842	1.8099	17.5471	99.9333	1.0579	
05-11C-4	0.1773	0.2998	63.6034	196.2567	2.5845	16.3763	99.9236	1.0268	
05-11C-5	0.2283	0.2329	31.6431	134.6421	3.3094	15.3531	99.9616	1.0238	
05-11C-6	0.2900	0.2751	7.8221	114.5111	3.9913	14.2413	99.9897	0.9758	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCC15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-11C-7	0.2678	0.2979	12.3521	121.3308	3.4955	14.7778	99.9843	0.9242	
05-11C-8	0.1547	1.3682	63.3511	301.0999	2.3186	10.6526	99.9205	1.0539	
05-11C-9	0.1811	0.5843	57.3382	265.9639	2.6568	16.3490	99.9301	1.0335	
05-11C-10	0.2417	0.3283	16.7176	195.4370	3.5245	15.3454	99.9790	1.0305	
05-11C-11	0.2972	0.3560	4.7133	163.1037	4.4524	14.2209	99.9932	1.0147	
05-11C-12	0.2153	1.5987	42.2750	237.0260	3.0107	15.7814	99.9444	0.9872	
05-11C-13	0.1044	6.0944	184.0947	236.1440	1.5621	18.0100	99.7626	1.0519	
05-11C-14	0.2122	0.3741	42.6595	229.8308	2.9501	15.8334	99.9481	0.9814	
05-11C-15	0.0732	33.5729	597.8694	224.5889	1.2081	18.4576	99.1847	1.1684	6
05-11C-16	0.1288	2.2604	72.2341	280.8994	1.9618	17.4510	99.9071	1.0694	
05-11C-17	0.3180	0.1664	4.3805	173.0264	4.8250	13.5916	99.9942	1.0777	
05-11C-18	0.0785	11.6312	134.6103	247.9316	1.2761	18.5962	99.8021	1.1391	
05-11C-19	0.1501	2.4707	26.9120	434.5964	2.2666	17.1576	99.9599	1.0612	
05-11C-20	0.2071	1.2779	16.9607	374.6909	3.0582	16.1416	99.9756	1.0410	
05-11C-21	0.2697	0.9815	3.8828	0.0	4.0139	0.0	99.9921	1.0535	
05-11C-22	0.0650	4.4460	86.6816	219.6575	1.0985	18.2471	99.8833	1.1818	6
05-11C-23	0.1110	1.1821	39.4893	295.5010	1.7405	17.4408	99.9495	1.0985	
05-11C-24	0.2648	0.5949	9.2750	228.2077	3.8895	14.5180	99.9869	1.0395	
05-11C-25	0.3295	0.4782	6.5283	191.8397	4.7943	13.5847	99.9906	1.0344	
05-11C-26	0.2068	0.7617	20.1849	338.6741	3.1101	15.6374	99.9735	1.0604	
05-11C-27	0.1414	1.4862	32.2538	384.2117	2.1212	16.6956	99.9569	1.0537	
05-11C-28	0.2358	1.0025	12.5435	258.4338	3.3973	15.3207	99.9817	1.0177	
05-11C-29	0.2966	0.7972	7.0260	195.8540	4.2670	13.9002	99.9889	1.0205	
05-11C-30	0.0848	0.6192	111.3260	117.8102	1.3598	18.2240	99.8669	1.1241	
05-11C-31	0.1435	0.1829	31.9905	340.1365	2.1188	17.1620	99.9616	1.0373	
05-11C-32	0.2033	0.1291	23.3223	277.9260	2.9636	16.0604	99.9719	1.0278	
05-11C-33	0.2640	0.3978	9.9190	186.7932	3.8219	14.7309	99.9868	1.0247	
05-11C-34	0.1747	0.4508	30.2140	333.7539	2.5516	16.4886	99.9627	1.0282	
05-11C-35	0.1132	1.6240	51.5541	211.8865	1.6903	17.5760	99.9337	1.0472	
05-11C-36	0.2642	0.3004	7.2506	312.8430	3.7474	14.8742	99.9903	1.0037	
05-12A-1	0.2012	0.1320	11.3479	113.4537	1.8580	16.2965	99.9860	0.8911	
05-12A-2	0.2732	0.1944	10.2295	107.4780	2.0221	15.0052	99.9870	0.9299	
05-12A-3	0.3515	0.1510	1.4651	97.7761	3.4771	13.5038	99.9977	0.9622	
05-12A-4	0.4883	0.1631	1.7747	56.1584	4.9390	11.0591	99.9973	0.9915	
05-12A-5	0.4216	0.1889	1.6505	66.1380	4.5307	11.9049	99.9973	1.0032	
05-12A-6	0.3915	0.1356	1.3268	72.6901	3.8812	12.7705	99.9979	0.9666	
05-12A-7	0.3526	0.1506	1.9362	84.7621	3.4996	13.5711	99.9971	0.9655	
05-12A-8	0.3134	0.1694	3.3268	99.6596	2.9438	14.3425	99.9954	0.9117	
05-12A-9	0.2924	0.1816	3.5812	110.0301	2.7853	14.5173	99.9951	0.9235	
05-12A-10	0.2764	0.1955	4.3476	98.4524	2.8928	14.5482	99.9941	1.0137	
05-12A-11	0.3108	0.4349	1.6639	152.1289	2.7862	13.7113	99.9965	0.8700	
05-12A-12	0.4216	0.2779	1.6216	98.1675	4.6097	11.8157	99.9971	1.0680	
05-12A-13	0.5742	0.2668	3.2970	95.1763	6.8634	0.0	99.9950	1.1776	
05-12A-14	0.3524	0.2301	1.4624	123.2992	3.7239	13.1419	99.9974	1.0281	
05-12A-15	0.2496	0.1805	2.7426	199.4187	2.5951	14.9510	99.9961	1.0055	
05-12A-16	0.2143	0.2102	6.4464	248.1199	2.1971	15.4721	99.9916	0.9899	
05-12A-17	0.1798	0.2004	7.6978	199.4857	1.7939	16.1792	99.9901	0.9612	
05-12A-18	0.1946	0.1851	7.9717	243.2989	1.9947	15.8332	99.9898	0.9883	
05-12A-19	0.2138	0.1685	6.4417	255.6072	2.2378	15.5368	99.9917	1.0103	
05-12A-20	0.1616	0.1115	6.4219	154.9554	1.6312	16.4405	99.9920	0.9716	
05-12A-21	0.1434	0.0628	4.8049	109.5280	1.4299	16.9434	99.9940	0.9587	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-12B-1	0.1896	0.4277	18.4510	98.6501	1.8265	16.5095	99.9765	0.9291	
05-12B-2	0.2282	0.1974	16.5165	104.9896	2.1154	15.9791	99.9771	0.8960	
05-12B-3	0.2589	0.1044	10.0921	100.0506	2.5998	15.1235	99.9875	0.9721	
05-12B-4	0.2948	0.1222	5.8959	88.7940	2.8993	14.6368	99.9925	0.9538	
05-12B-5	0.3464	0.1040	5.0146	74.1699	3.4362	13.8102	99.9936	0.9649	
05-12B-6	0.4023	0.1120	5.8837	66.1022	4.0270	12.7481	99.9949	0.9767	
05-12B-7	0.2109	0.2136	9.9286	191.2819	1.8812	16.5161	99.9874	0.8610	3
05-12B-8	0.1425	0.1897	8.5252	67.3412	1.2587	17.7638	99.9892	0.8495	3
05-12B-9	0.1700	0.0530	9.1827	95.8849	1.4608	17.2407	99.9888	0.8275	3
05-12B-10	0.2494	0.1445	6.2643	193.6481	2.3232	15.7243	99.9920	0.9011	
05-12B-11	0.2871	0.1255	4.8693	156.9794	2.7731	14.6735	99.9937	0.9364	
05-12B-12	0.3361	0.1608	4.1120	123.0079	3.2123	13.9930	99.9945	0.9291	
05-12B-13	0.3789	0.0713	5.0662	106.4566	3.6670	13.0223	99.9936	0.9430	
05-13A-1	0.1274	0.7073	6.7265	48.8555	1.2303	17.5072	99.9896	0.9277	
05-13A-2	0.1623	0.0555	6.3562	40.5807	1.4840	16.9932	99.9922	0.8799	
05-13A-3	0.1603	0.4497	9.7023	56.4839	1.5436	16.6611	99.9869	0.9271	
05-13A-4	0.1919	0.3287	13.4579	86.5898	1.8303	16.1461	99.9828	0.9200	
05-13A-5	0.2209	0.2855	13.3687	125.8989	2.0888	15.5337	99.9830	0.9136	
05-13A-6	0.2809	0.2566	4.9037	107.9939	2.7013	14.2830	99.9932	0.9319	
05-13A-7	0.3136	0.2586	2.7366	88.6065	3.1045	13.5734	99.9958	0.9611	
05-13A-8	0.4120	0.1531	6.4897	76.0618	4.2425	12.2754	99.9916	1.0053	
05-13A-9	0.3540	0.1527	5.6496	90.8381	3.5776	13.3056	99.9927	0.9833	
05-13A-10	0.3023	0.1788	6.6112	107.7318	3.0921	14.3083	99.9914	0.9924	
05-13A-11	0.2833	0.1590	9.4239	107.9610	2.7691	14.5347	99.9881	0.9473	
05-13A-12	0.2389	0.1886	17.6929	115.3846	2.3656	15.2543	99.9781	0.9577	
05-13A-13	0.2008	0.2243	21.1057	91.0375	1.9628	15.8686	99.9740	0.9433	
05-13A-14	0.1686	0.3741	18.5393	65.8652	1.6361	16.4679	99.9766	0.9350	
05-13A-15	0.3504	0.2057	5.6996	87.4775	3.4689	13.2026	99.9924	0.9631	
05-13A-16	0.2761	0.2284	11.3488	104.0506	2.7278	14.3785	99.9856	0.9572	
05-13A-17	0.1514	0.3931	21.2026	58.0633	1.3959	17.4690	99.9734	0.8876	
05-13A-18	0.2008	0.4657	19.7741	134.7631	1.8935	16.7261	99.9748	0.9101	
05-13A-19	0.2203	0.3472	14.6183	190.7081	2.1104	16.1363	99.9813	0.9254	
05-13A-20	0.2445	0.3128	14.7211	219.5906	2.2730	15.9119	99.9813	0.8992	
05-13A-21	0.2641	0.2574	11.5040	222.3725	2.4507	15.5141	99.9853	0.8985	
05-13A-22	0.2851	0.2385	9.9445	209.7675	2.7067	14.3670	99.9872	0.9204	
05-13A-23	0.3068	0.2216	9.2402	193.8802	2.9068	14.4351	99.9881	0.9195	
05-13A-24	0.3325	0.2300	8.5257	149.8293	3.2112	13.8999	99.9889	0.9386	
05-13A-25	0.4061	0.2093	7.9131	88.1323	4.0292	12.4093	99.9897	0.9684	
05-13A-26	0.3590	0.2131	7.3668	112.1954	3.4816	13.2891	99.9904	0.9439	
05-13A-27	0.2225	0.2291	23.9962	123.7737	2.0845	15.7658	99.9705	0.9053	
05-13A-29	0.2933	0.1738	10.3508	115.7906	2.7084	14.5885	99.9870	0.8955	
05-14A-1	0.1417	1.3395	64.8321	34.5916	1.3447	17.4154	99.9182	0.9142	
05-14A-2	0.1676	0.3086	20.1052	39.6489	1.5908	16.8496	99.9749	0.9144	
05-14A-3	0.2018	0.0854	22.4708	58.6252	1.9699	16.2788	99.9728	0.9421	
05-14A-4	0.2392	0.1802	14.8857	57.2435	2.2557	15.6154	99.9815	0.9121	
05-14A-5	0.2596	0.0996	12.9682	61.7620	2.5430	15.0689	99.9841	0.9482	
05-14A-6	0.2753	0.0626	12.9136	63.6401	2.7350	14.6326	99.9843	0.9626	
05-14A-7	0.3102	0.1111	9.5753	61.2528	3.0108	14.1696	99.9881	0.9423	
05-14A-8	0.3309	0.1303	8.4025	60.1878	3.2583	13.6877	99.9894	0.9571	
05-14A-9	0.3930	0.1316	6.6043	61.6958	3.9007	12.5385	99.9916	0.9680	
05-14A-10	0.1256	0.3417	23.3279	45.6727	1.2571	17.9962	99.9711	0.9622	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-14A-11	0.1725	0.0498	15.8640	55.1555	1.6556	17.1970	99.9809	0.9249	
05-14A-12	0.2059	0.0834	16.0501	90.2889	2.0542	16.1770	99.9805	0.9631	
05-14A-13	0.2517	0.0341	10.1047	95.5610	2.4993	15.3649	99.9877	0.9607	
05-14A-14	0.2957	0.1741	6.5716	99.7930	2.9335	14.5843	99.9891	0.9624	
05-14A-15	0.3415	0.1507	7.4693	101.3402	3.5206	13.6014	99.9905	1.0025	
05-14A-16	0.3966	0.1731	6.4126	98.7434	4.2312	12.2298	99.9916	1.0406	
05-15A-1	0.1361	1.0182	21.8756	59.7470	1.3857	17.4598	99.9705	0.9787	
05-15A-2	0.1703	0.4067	18.5764	96.6436	1.6853	16.8714	99.9764	0.9532	
05-15A-3	0.2007	0.3451	20.5085	138.1227	2.0575	16.1768	99.9743	0.9894	
05-15A-4	0.2467	0.1755	20.5486	133.1729	2.4580	15.4643	99.9747	0.9642	
05-15A-5	0.2875	0.1807	16.9634	103.3404	2.9225	14.6330	99.9790	0.9857	
05-15A-6	0.3355	0.1548	12.2427	72.3049	3.4580	13.7248	99.9847	1.0021	
05-15A-7	0.3978	0.1306	8.7521	59.5769	4.1426	12.4604	99.9890	1.0159	
05-15A-8	0.3566	0.1700	11.0070	64.1139	3.6904	13.2220	99.9861	1.0073	
05-15A-9	0.1232	0.8440	27.2735	71.3506	1.2164	17.2340	99.9647	0.9493	
05-15A-10	0.1745	0.4963	23.6224	133.0432	1.6597	16.4354	99.9701	0.9167	
05-15A-11	0.2059	0.4028	15.3464	226.3174	2.0417	15.7490	99.9801	0.9572	
05-15A-12	0.2459	0.3522	15.1362	240.7601	2.4479	15.0361	99.9806	0.9632	
05-15A-13	0.2922	0.2964	12.1825	177.0199	2.8441	14.5843	99.9843	0.9441	
05-15A-14	0.3372	0.3083	9.3906	116.7672	3.4107	13.4472	99.9876	0.9836	
05-15A-15	0.3902	0.2664	9.1097	85.6623	4.0794	12.3790	99.9881	1.0196	
05-15A-16	0.3655	0.2844	9.1828	94.4934	3.6930	13.1580	99.9879	0.9839	
05-16A-1	0.1464	0.2355	22.2470	102.7158	2.1830	16.6740	99.9729	1.0475	
05-16A-2	0.1355	0.0636	23.9212	90.4041	2.1446	16.6396	99.9715	1.1105	
05-16A-3	0.1341	0.0643	24.0997	89.7392	2.1433	16.7282	99.9713	1.1211	
05-16A-4	0.1984	0.1738	45.7901	172.5751	3.0056	15.5633	99.9451	1.0684	
05-16A-5	0.2269	0.1140	21.3468	205.4362	3.4557	14.8315	99.9742	1.0755	
05-16A-6	0.2550	0.1014	7.2325	196.8612	3.7739	14.2407	99.9910	1.0467	
05-16A-7	0.2843	0.0607	15.5685	184.9471	4.2560	13.7019	99.9812	1.0611	
05-16A-8	0.3091	0.0558	11.0956	172.8468	4.6351	13.0446	99.9865	1.0644	
05-16A-9	0.3106	0.0555	7.2094	177.5367	4.6306	12.8856	99.9912	1.0584	
05-17A-1	0.0646	14.4031	36.1484	84.4839	1.2691	18.5469	99.9095	1.3734	3
05-17A-2	0.0705	12.3562	36.6261	85.6961	1.2855	18.2258	99.9157	1.2736	3
05-17A-3	0.1293	7.1929	34.5262	155.2810	2.0600	17.0424	99.9351	1.1182	3
05-17A-4	0.1939	2.3960	32.6842	164.7903	2.9362	15.6114	99.9532	1.0670	
05-17A-5	0.2563	1.3599	26.6127	136.0840	3.7315	14.4465	99.9637	1.0305	
05-17A-6	0.3248	1.4307	18.0537	125.9146	4.6312	0.0	99.9735	1.0135	
05-17A-7	0.2537	2.2897	29.6265	146.7292	3.7163	14.4345	99.9570	1.0365	
05-17A-8	0.3193	0.1818	13.2344	128.5052	4.4646	13.1760	99.9836	0.9935	
05-17A-9	0.2561	0.2267	11.9355	152.9481	3.6475	14.3334	99.9850	1.0076	
05-18A-1	0.0828	136.7854	1107.5258	48.6789	1.2468	18.7996	98.2397	1.0828	
05-18A-2	0.0796	363.1594	1339.1699	42.9869	1.2120	19.1688	97.2119	1.1055	
05-18A-3	0.1396	10.4673	55.5720	67.7526	2.0947	17.9946	99.8992	1.0544	
05-18A-4	0.2031	1.7995	23.1194	84.3066	2.9866	16.1689	99.9665	1.0368	
05-18A-5	0.2657	0.6879	14.1042	83.2247	3.8328	14.6934	99.9809	1.0213	
05-18A-6	0.3226	0.3776	10.9253	82.5699	4.5953	13.5871	99.9856	1.0121	
05-18A-7	0.3531	0.8626	9.9624	88.5646	5.0389	12.7733	99.9851	1.0162	
05-18A-8	0.0124	24.5484	56.6016	43.1235	0.1863	19.5059	99.8521	1.0465	
05-18A-9	0.0786	94.3199	1077.6394	64.6506	1.1051	18.1541	98.4171	1.0115	
05-18A-10	0.1997	2.1347	18.8134	108.9614	2.7543	15.7948	99.9705	0.9720	
05-19A-1	0.0	0.0	0.0	0.0	0.0	0.0			

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA

SCHEME	EQR	MCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-19B-1	0.1369	77.4030	953.7671	67.3177	2.0496	17.2539	98.6139	1.0757	
05-19B-2	0.2659	1.7361	19.4568	99.7465	3.9986	14.6368	99.9709	1.0646	
05-19B-3	0.3561	0.8098	10.5971	106.6156	5.2182	12.8749	99.9845	1.0435	
05-19B-4	0.0865	4.6684	54.4342	125.2742	1.3216	18.0509	99.9203	1.0694	
05-19B-5	0.1549	1.4888	45.8339	114.3487	2.2106	16.7216	99.9408	1.0033	
05-19B-6	0.1525	6.4451	71.2781	116.6382	2.2216	16.8653	99.8941	1.0251	
05-19B-7	0.1395	0.8267	54.4014	105.9940	1.9531	17.2085	99.9329	0.9839	
05-19B-8	0.1899	1.2145	22.3428	115.8753	2.7204	16.2028	99.9694	1.0090	
05-20A-1	0.0906	33.8143	313.9219	130.0542	1.3834	18.0340	99.5173	1.0766	
05-20A-2	0.1163	16.7146	142.0124	169.1842	1.7153	17.4001	99.7765	1.0367	
05-20A-3	0.1489	7.9098	136.2383	201.6971	2.1438	16.7208	99.8124	1.0142	
05-20A-4	0.2313	8.6449	398.5876	151.2742	3.2105	15.1920	99.4969	0.9899	
05-21A-1	0.1408	101.9119	342.2339	140.6757	1.9466	17.2199	99.2540	0.9808	
05-21A-2	0.1520	105.3470	342.3896	117.3805	2.1131	16.8396	99.2417	0.9871	
05-21A-3	0.1202	120.3832	303.9666	148.3959	1.6822	17.4399	99.2384	0.9907	
05-21A-4	0.0984	153.3158	233.7622	122.4252	1.3913	17.8553	99.2121	0.9984	
05-21A-5	0.0701	247.9282	263.7859	62.0488	1.0030	18.4442	98.8628	1.0122	
05-22A-1	0.2087	2.0339	74.6912	78.2722	3.0560	16.0018	99.9045	1.0339	
05-22A-2	0.2701	0.3916	34.8954	86.0931	3.9384	14.8601	99.9571	1.0332	
05-22A-3	0.3195	0.0	18.4065	96.9591	4.6480	13.7072	99.9780	1.0337	
05-22A-4	0.3708	0.1425	13.9512	97.7816	5.4140	12.3639	99.9828	1.0408	
05-22A-5	0.1522	6.6692	111.7827	60.9161	2.2061	16.2887	99.8454	1.0205	
05-23A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
05-23A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
05-23B-1	0.2168	6.1406	52.8112	85.4828	3.2722	15.5288	99.9098	1.0662	
05-23B-2	0.2873	2.2780	22.7167	91.3735	4.2223	14.6369	99.9652	1.0420	
05-23B-3	0.3737	0.7270	14.3495	95.2466	5.6155	12.6686	99.9803	1.0715	
05-23B-4	0.1550	2.8095	39.1002	76.1518	2.3217	16.9378	99.9443	1.0532	
05-23B-5	0.0991	139.0576	834.2009	47.4754	1.4505	17.9667	98.5522	1.0479	
05-23B-6	0.1268	17.4777	342.1741	61.8819	1.8788	17.3074	99.5375	1.0479	
05-23B-7	0.1811	2.1024	30.8779	85.8693	2.6466	16.2828	99.9563	1.0290	
05-23B-8	0.0919	124.5108	1068.2705	76.0944	1.3292	18.3630	98.3259	1.0404	
05-23B-9	0.1510	28.8100	31.8321	120.3497	2.2170	17.2120	99.8657	1.0324	
05-23B-10	0.2000	15.0703	22.8901	124.7169	2.9155	16.1574	99.9221	1.0280	
05-23B-11	0.2472	6.6842	20.3712	134.9771	3.5717	15.0097	99.9532	1.0217	
05-23B-12	0.2076	10.3477	20.4241	166.3260	2.9697	0.0	99.9409	1.0089	
05-23B-13	0.1574	4.5467	27.0604	167.3803	2.2432	0.0	99.9527	1.0020	
05-23B-14	0.1018	187.0884	1376.8459	56.4028	1.4425	0.0	97.7519	1.0299	
05-23B-15	0.4321	1.5181	10.9541	165.6449	6.1452	0.0	99.9816	1.0181	
05-23B-16	0.3039	1.1773	9.3388	162.5061	4.3200	0.0	99.9848	1.0089	
05-23B-17	0.2632	0.9060	14.3796	164.3368	3.6951	0.0	99.9798	0.9936	
05-23B-18	0.3460	0.6893	9.5701	159.9471	4.8862	0.0	99.9862	1.0050	
05-23B-19	0.3878	0.3075	7.3169	160.9639	5.3976	0.0	99.9902	0.9932	
05-23B-20	0.2173	52.3849	33.0111	90.7822	3.1083	16.2363	99.7843	1.0112	
05-23B-21	0.1222	4.7874	51.1028	159.1919	1.8565	17.4201	99.9237	1.0663	
05-23B-22	0.1674	1.8998	40.0686	153.4583	2.6076	16.9497	99.9462	1.0960	
05-24A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
05-24B-1	0.1245	24.7224	198.6777	126.5233	1.8766	18.0357	99.6827	1.0616	
05-24B-2	0.1525	21.7224	159.1590	133.8759	2.2322	17.3913	99.7389	1.0324	
05-25A-1	0.1310	14.5009	113.9736	105.6060	1.8124	17.7641	99.8168	0.9736	
05-25A-2	0.1669	4.3483	110.7422	120.2074	2.3121	16.9529	99.8543	0.9766	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	NCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
05-25A-3	0.4052	0.2534	10.8961	101.4544	5.7536	12.1079	99.9860	1.0146	
05-25A-4	0.3518	0.4381	12.5303	102.8506	4.9771	13.1097	99.9835	1.0072	
05-25A-5	0.3066	0.1673	23.5104	105.5650	4.3073	13.8525	99.9713	0.9975	
05-25A-6	0.2585	0.5964	22.5224	121.5679	3.6318	14.7337	99.9711	0.9944	
05-25A-7	0.2143	0.4791	45.6268	138.7495	3.0693	15.5242	99.9442	1.0111	
05-25A-8	0.1676	1.5353	70.9667	138.0568	2.3492	16.4438	99.9108	0.9871	
05-25A-9	0.1298	4.3808	73.6063	118.2063	1.8319	17.1915	99.8984	0.9911	
05-25A-10	0.4058	0.1264	24.0256	102.9219	5.7153	11.8207	99.9707	1.0066	
05-26A-1	0.1553	9.3137	63.7216	113.6043	2.1951	17.4052	99.8934	0.9939	
05-26A-2	0.2068	2.0094	34.0829	117.4306	2.9356	16.3356	99.9528	1.0014	
05-26A-3	0.2617	0.7919	19.7409	113.4431	3.7028	15.2410	99.9738	1.0014	
06-01A-1	0.1756	0.8461	23.0782	30.6443	1.7274	17.1550	99.9696	0.9483	
06-01A-2	0.2478	0.4937	15.4822	98.8003	2.4704	15.7977	99.9797	0.9647	
06-01A-3	0.3071	0.3414	12.4385	145.6424	3.0392	14.6617	99.9839	0.9608	
06-02A-1	0.1756	0.4826	7.2528	43.2450	1.8547	16.8423	99.9897	1.0173	
06-02A-2	0.2911	0.1820	3.5133	144.4434	2.8555	14.4320	99.9951	0.9512	
06-03A-1	0.1724	0.5531	7.4589	50.5547	1.8285	16.8495	99.9892	1.0216	
06-03A-2	0.2559	0.2691	6.0284	124.2501	2.6992	15.2043	99.9918	1.0205	
06-03A-3	0.0880	4.3645	246.2350	37.3296	0.9256	18.6651	99.6926	1.0165	
06-03A-4	0.1183	2.7076	134.3299	56.4165	2.0234	22.9374	97.3277	1.4791	
06-04A-1	0.0659	5.4621	602.2212	85.5355	0.6100	18.7064	99.2668	0.9058	
06-05A-1	0.0844	2.6036	285.9824	38.0727	0.8445	17.9925	99.6514	0.9680	
06-05A-2	0.1190	1.7143	122.6566	35.1304	1.0637	17.4994	99.8482	0.8625	
06-05A-3	0.1611	5.7497	84.5509	52.0070	1.5364	16.8006	99.8796	0.9218	
06-05A-4	0.2251	0.0588	234.4352	70.9968	2.1250	15.6683	99.7190	0.9145	
06-05A-5	0.2786	0.0285	6.3476	82.9839	2.5997	14.7559	99.9923	0.9040	
06-05A-6	0.0539	3.9786	413.5615	137.7866	0.7548	24.5798	91.9040	1.3556	3
06-05A-7	0.0659	3.2559	520.8848	87.2609	0.8682	24.2719	89.8909	1.2814	3
06-05A-8	0.0783	2.0298	478.2168	59.9813	0.9687	24.0188	90.7643	1.2037	3
06-05A-9	0.0914	1.6522	330.2756	44.4484	1.0838	23.7731	93.6031	1.1504	3
06-05A-10	0.1278	0.5595	88.2408	112.5694	2.2572	22.0357	98.2469	1.3922	3
06-05A-11	0.1393	0.4182	107.4041	92.8528	2.3969	21.8555	97.9166	1.3879	3
06-05A-12	0.1521	0.2960	92.6681	77.2813	2.5247	21.5232	98.2175	1.3584	3
06-05A-13	0.1623	0.2122	63.5680	69.4377	2.6865	21.3617	98.7825	1.3757	3
06-05A-14	0.1911	0.1525	14.6995	67.6542	3.0456	20.5029	99.7134	1.3472	3
06-05A-15	0.1101	1.0106	82.6312	38.7753	1.3231	22.8941	98.3654	1.1585	3
06-05A-16	0.1199	1.1516	55.1881	35.1415	1.5260	22.6637	98.8819	1.2377	3
06-05A-17	0.1567	0.5318	21.9495	51.5067	2.4782	21.2993	99.5569	1.4115	3
06-05A-18	0.1880	0.2288	11.6662	61.2060	3.0821	20.4858	99.7672	1.4093	3
06-05A-19	0.2052	0.2228	7.6152	71.7442	3.4049	19.7487	99.8436	1.4027	3
06-05A-20	0.2192	0.1840	8.5608	82.6643	3.7354	19.2865	99.8272	1.4231	3
06-05A-21	0.2337	0.1841	9.3288	94.6400	4.0328	18.8729	99.8117	1.4265	3
06-05A-22	0.1248	0.8824	33.0306	37.4561	1.6131	22.1708	99.3775	1.2445	3
06-05A-23	0.0766	2.4517	298.9869	49.0173	1.0896	22.9836	94.1699	1.3746	3
06-05A-24	0.0895	2.1281	472.3159	42.7562	1.0704	22.8941	90.8656	1.1640	3
06-05A-25	0.1502	0.0	158.2030	58.4661	2.3624	21.3889	97.0068	1.3201	3
06-05A-26	0.1331	0.0	186.3385	54.8379	2.1362	21.7026	96.4494	1.3685	3
06-05A-27	0.1247	0.0	244.5988	55.7249	2.0083	21.7834	95.3951	1.3930	3
06-05A-28	0.1151	0.0	340.2734	64.3498	1.8166	22.6000	93.5972	1.3884	3
06-05A-29	0.0612	0.0	354.4653	70.4593	1.2877	23.4187	17.5160	1.4789	3
06-05A-30	0.0475	0.0	344.4448	70.1111	1.0619	23.8277	19.9231	1.5698	3

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
07-01A-1	0.0	0.0	0.0	0.0	0.0	0.0			
07-02A-1	0.2074	1.4839	46.0415	131.7238	3.1713	15.7292	99.9403	1.0787	
07-02A-2	0.2251	0.0	42.3694	23.2980	3.4052	16.0043	99.9496	1.0686	
07-02A-3	0.2718	0.0	30.0137	124.1977	4.0233	14.5009	99.9642	1.0485	
07-02A-4	0.2529	0.0	18.3884	107.7390	3.8127	15.1007	99.9781	1.0662	
07-02A-5	0.2210	0.0	46.3234	50.1717	3.0553	15.9915	99.9449	0.9764	
07-02B-1	0.2071	5.4148	43.5572	136.6872	3.0881	15.8465	99.9301	1.0524	
07-02B-2	0.1744	5.8079	37.1293	107.5227	2.6925	16.4229	99.9365	1.0868	
07-02B-3	0.1661	6.7480	193.2475	42.8016	2.5432	16.6104	99.7486	1.0808	
07-02B-4	0.2688	4.1715	33.6043	135.7211	4.1462	14.5368	99.9458	1.0928	
07-02B-5	0.2668	4.4057	19.9542	102.1814	3.6658	15.0800	99.9613	0.9730	
07-02B-6	0.2369	3.1398	17.5665	82.0568	3.4659	15.2343	99.9685	1.0340	
07-02B-7	0.3272	1.2931	16.2343	164.7182	4.6403	13.6356	99.9762	1.0081	
07-02B-8	0.2983	1.2403	13.1820	130.8057	4.3356	14.0456	99.9800	1.0312	
07-02B-9	0.2044	1.2907	14.6891	141.6438	3.0738	15.7462	99.9782	1.0599	
07-03A-1	0.2357	4.5396	22.5409	135.3009	3.6321	15.2542	99.9579	1.0890	
07-03A-2	0.2140	3.9131	21.4317	96.8322	3.3240	15.5481	99.9614	1.0959	
07-03A-3	0.2419	2.2973	27.9728	158.2323	3.8075	14.9575	99.9590	1.1129	
07-03A-4	0.2237	2.0291	21.5880	109.1778	3.4428	15.3957	99.9675	1.0867	
07-03A-5	0.2000	2.1419	22.9283	73.2655	3.1535	15.6911	99.9656	1.1112	
07-03A-6	0.1789	1.9701	21.6173	26.9635	2.7926	16.2355	99.9678	1.0989	
07-03A-7	0.1920	1.5719	20.1394	34.6115	2.9776	16.0205	99.9708	1.0926	
07-03A-8	0.2353	2.6845	64.3207	82.1817	3.4351	15.3349	99.9144	1.0327	
07-03A-9	0.2186	3.0111	42.6971	59.9002	3.1452	15.7870	99.9391	1.0162	
07-03A-10	0.2012	2.6755	33.3202	23.4200	2.9973	15.9953	99.9508	1.0504	
07-03A-11	0.2319	2.1529	27.8371	94.2095	3.4242	15.4213	99.9596	1.0433	
07-03A-12	0.2002	2.7583	28.6954	24.2368	2.9869	16.0567	99.9567	1.0520	
07-03A-13	0.2013	2.6109	27.3168	19.6004	2.9225	16.0027	99.9588	1.0234	
07-03A-14	0.2854	1.1944	14.2409	51.6085	4.2022	14.2384	99.9790	1.0435	
07-03A-15	0.2812	1.1189	12.7346	41.6200	4.1380	14.4357	99.9810	1.0428	
07-03A-16	0.3065	1.0265	11.6749	87.6352	4.4674	13.8334	99.9826	1.0346	
07-03A-17	0.3161	0.9121	9.8084	116.8174	4.7142	13.4528	99.9852	1.0593	
07-04A-1	0.2125	10.6997	40.0431	102.0338	3.1534	15.7805	99.9164	1.0475	
07-05A-1	0.2529	1.4776	18.4793	112.9221	3.6583	14.9636	99.9730	1.0232	
07-05A-2	0.2291	1.0473	12.2328	61.6542	3.4748	15.2370	99.9819	1.0710	
07-05A-3	0.2237	0.9534	12.5216	38.3072	3.2871	15.3168	99.9819	1.0374	
07-05A-4	0.2165	0.8615	11.8197	24.6903	3.1357	15.4807	99.9830	1.0217	
07-06A-1	0.2573	7.1033	16.5705	139.3712	3.7803	14.9061	99.9563	1.0398	
07-06A-2	0.2370	3.1482	17.9587	109.5060	3.5481	15.2242	99.9680	1.0577	
07-06A-3	0.2154	3.2226	16.4471	79.9884	3.2457	15.6064	99.9696	1.0630	
07-06A-4	0.2096	2.4481	13.5021	51.0007	3.1091	15.7554	99.9757	1.0463	
07-06A-5	0.2049	2.0005	15.0071	41.7640	3.0133	15.8538	99.9754	1.0370	
07-06A-6	0.1966	1.6922	15.6071	37.7299	2.9138	16.0194	99.9758	1.0445	
07-06A-7	0.1890	1.6238	18.7322	33.9438	2.8932	16.2119	99.9723	1.0780	
07-06A-8	0.1771	3.4807	24.0340	26.5223	2.6417	16.2389	99.9598	1.0498	
07-06A-9	0.2625	5.1383	23.3067	145.7157	3.8892	14.4055	99.9549	1.0488	
07-06A-10	0.2420	2.7619	16.4993	120.0995	3.6126	14.9111	99.9710	1.0552	
07-06A-11	0.2219	2.3120	13.7516	85.6889	3.2918	15.3134	99.9759	1.0471	
07-06A-12	0.2009	2.0396	14.0254	37.0143	2.9776	15.7603	99.9765	1.0444	
07-06A-13	0.1883	2.1765	19.9681	19.2206	2.7621	16.1023	99.9690	1.0331	
07-07A-1	0.2460	1.4567	24.9077	129.1317	3.6702	15.1817	99.9654	1.0550	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EGR	MCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
07-07A-2	0.2261	1.0172	18.7164	97.2157	3.3048	15.5519	99.9743	1.0322	
07-07A-3	0.2038	1.0027	19.6206	68.8177	3.0266	16.0220	99.9733	1.0471	
07-07A-4	0.1857	0.8246	21.4986	39.3036	2.6832	16.4809	99.9717	1.0174	
07-07A-5	0.2699	3.3877	22.8041	134.6251	3.8192	15.0332	99.9613	1.0021	
07-07A-6	0.2469	2.0008	16.2830	118.1741	3.4956	15.2242	99.9739	1.0012	
07-07A-7	0.2232	1.5116	13.7575	74.3826	3.1398	15.6881	99.9785	0.9931	
07-07A-8	0.1991	1.0408	14.2287	52.6913	2.7864	16.1427	99.9796	0.9861	
07-07A-9	0.1997	1.1680	9.4481	140.6568	2.8761	15.9872	99.9848	1.0149	
07-07A-10	0.1876	1.1049	10.0650	105.3275	2.7006	16.2230	99.9843	1.0137	
07-07A-11	0.1743	1.4874	10.8405	69.7851	2.4989	16.4516	99.9822	1.0086	
07-07A-12	0.1668	1.0868	15.5788	50.3936	2.3883	16.6024	99.9779	1.0067	
07-07A-13	0.1603	1.6174	22.0917	41.9949	2.2886	16.6240	99.9684	1.0038	
07-07A-14	0.1565	1.8231	91.2190	30.9597	2.2234	16.7320	99.8860	1.0005	
07-07A-15	0.2540	1.2255	8.3749	156.1847	3.5254	14.9783	99.9859	0.9816	
07-07A-16	0.2277	1.2528	10.3607	106.3244	3.1248	15.5092	99.9835	0.9690	
07-07A-17	0.2113	1.2269	12.2913	87.3201	2.8935	15.7734	99.9813	0.9658	
07-07A-18	0.2049	1.5195	11.5313	73.9036	2.7853	15.9444	99.9812	0.9585	
07-07A-19	0.1909	1.2220	13.6169	52.0704	2.5976	16.2365	99.9797	0.9586	
07-07A-20	0.1748	1.4830	22.9310	34.4980	2.3656	16.4809	99.9678	0.9524	
07-07A-21	0.1646	0.1570	17.2102	46.8163	2.4158	16.8692	99.9791	1.0316	
07-07A-22	0.1811	0.4285	13.0354	98.8567	2.6506	16.4594	99.9831	1.0301	
07-07A-23	0.1731	0.2988	12.2715	77.0793	2.5481	16.6533	99.9845	1.0354	
07-07A-24	0.1661	0.3113	12.7771	49.7581	2.3946	16.8120	99.9838	1.0134	
07-07A-25	0.1580	0.1637	22.4266	40.3996	2.3174	16.9990	99.9729	1.0309	
07-07A-26	0.1516	0.0	43.6385	34.2476	2.2060	17.1655	99.9484	1.0227	
07-07A-27	0.2980	2.6259	11.0858	224.1347	4.2160	0.0	99.9779	1.0035	
07-07A-28	0.2833	0.9151	10.8360	207.4714	3.9926	0.0	99.9840	0.9988	
07-07A-29	0.2588	0.6003	11.8446	179.6286	3.6296	0.0	99.9839	0.9923	
07-07A-30	0.2372	0.5456	11.9517	151.4274	3.2927	0.0	99.9839	0.9806	
07-07A-31	0.2134	0.4851	14.3666	120.7430	2.9377	0.0	99.9813	0.9712	
07-07A-32	0.2046	0.2528	13.8263	105.4457	2.7997	0.0	99.9827	0.9646	
07-07A-33	0.1934	0.2675	15.8530	87.6261	2.6455	0.0	99.9803	0.9638	
07-07A-34	0.1832	0.1411	16.7314	77.6684	2.4968	0.0	99.9797	0.9594	
07-07A-35	0.1727	0.0	17.8000	66.2015	2.3458	0.0	99.9789	0.9556	
07-07A-36	0.1680	0.3079	21.0649	59.7195	2.2718	0.0	99.9740	0.9514	
07-07A-37	0.1586	0.1630	23.8269	46.8076	2.1324	0.0	99.9713	0.9449	
07-07A-38	0.1459	0.5320	42.1683	28.5936	1.9380	0.0	99.9484	0.9337	
07-07A-39	0.1779	1.3113	11.9498	151.3788	2.5416	0.0	99.9814	1.0055	
07-07A-40	0.1649	1.0993	14.3224	117.0382	2.3362	0.0	99.9794	0.9960	
07-07A-41	0.1523	1.0203	15.4801	85.2162	2.1403	0.0	99.9783	0.9875	
07-07A-42	0.1473	1.0548	19.2095	76.6870	2.0792	0.0	99.9737	0.9915	
07-07A-43	0.1424	0.7266	28.1768	64.9937	1.9907	0.0	99.9643	0.9814	
07-07A-44	0.2344	0.1103	16.1135	156.9878	3.2008	0.0	99.9805	0.9646	
07-07A-45	0.2125	0.0	16.9183	127.3726	2.8720	0.0	99.9775	0.9536	
07-07A-46	0.1964	0.0	21.6668	105.6366	2.6293	0.0	99.9743	0.9432	
07-07A-47	0.1334	0.3877	0.0	55.1436	0.0	0.0	99.9987	0.0000	
11-01A-1	0.2828	1.6400	15.0261	83.1482	4.6027	13.8547	99.9765	1.1534	
11-01A-2	0.3855	38.0732	10.5316	161.1448	6.1966	11.4869	99.8576	1.1480	
11-01A-3	0.2497	0.0	0.0	0.0	0.0	0.0	-	-	
11-02A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-03A-1	0.0067	277.3020	1579.3638	45.4335	0.0856	19.4988	97.2297	0.9364	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
11-04A-1	0.0187	101.1530	7[illegible].4346	97.7688	0.1761	20.1724	99.5765	0.6605	3 6
11-05A-1	0.2132	0.0	0.0	0.0	0.0	0.0	-	-	
11-06A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-06A-2	0.3372	0.0	0.0	0.0	0.0	0.0	-	-	
11-07A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-07A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-08A-1	0.1387	9.9211	3085.1125	8.6956	4.6522	14.7381	99.3409	1.1976	11
11-08A-2	0.1912	1.9982	1800.2554	5.9105	6.0465	13.4440	99.6001	1.1668	11
11-08A-3	0.2497	0.8729	213.4125	5.1309	7.7383	11.5670	99.9498	1.1785	11
11-08A-4	0.3066	0.8833	67.4216	6.0921	9.1920	10.0646	99.9830	1.1840	11
11-09A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-09A-2	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
11-10A-1	0.1578	4.1489	1347.8357	17.1386	4.6192	15.1641	99.7074	1.0460	
11-10A-2	0.1235	7.0810	1939.9736	21.8922	3.6853	16.1142	99.5906	1.0412	
11-10A-3	0.0926	8.8546	2320.0635	28.4059	2.9809	16.7832	99.5236	1.0957	
11-11A-1	0.0262	63.1323	42.2201	169.4908	0.2491	19.4089	99.7405	0.6646	3
11-12A-1	0.3461	2.0529	17.4205	137.3067	4.9756	13.0974	99.9721	1.0234	
11-12A-2	0.3246	0.5025	17.1379	130.5056	4.6282	13.5607	99.9778	1.0133	
11-12A-3	0.2969	0.0	27.4215	122.5374	4.1615	13.8953	99.9672	0.9946	
14-01A-1	0.1359	0.0	0.0	0.0	0.0	0.0	-	-	
14-01A-2	0.1428	0.0	0.0	0.0	0.0	0.0	-	-	
14-01A-3	0.1326	0.5202	20.5811	99.4595	1.2836	18.2542	99.9737	0.9309	
14-02A-1	0.3550	0.0486	2.3156	97.6867	3.9901	13.1395	99.9970	1.0936	
14-02A-2	0.2251	1.8525	33.5914	78.2348	2.2961	16.0599	99.9535	0.9862	
14-02A-3	0.2805	0.2368	9.5620	62.7700	2.8003	14.9611	99.9877	0.9674	
14-02A-4	0.3187	1.3614	5.3369	61.8975	3.3183	14.0708	99.9889	1.0113	
14-02A-5	0.3735	0.6684	3.9163	59.0044	3.9032	12.8147	99.9930	1.0179	
14-02A-6	0.3059	0.2987	2.3877	70.9432	3.3410	13.8087	99.9961	1.0599	
14-02A-7	0.2354	0.5294	11.3877	87.8602	2.4009	15.4893	99.9845	0.9860	
14-02A-8	0.3447	0.3615	1.4183	69.6437	3.8137	13.0463	99.9970	1.0757	
16-01A-1	0.2684	16.3698	57.0394	44.6569	3.3445	15.8946	99.8767	0.8838	
16-01A-2	0.2486	7.3508	283.5364	33.3336	3.0269	16.6882	99.6377	0.8678	
16-01A-3	0.2601	2.8694	65.7781	42.7489	3.2166	16.4174	99.9119	0.8766	
16-01B-1	0.2483	113.6652	2491.9587	41.4231	2.4184	17.2005	96.6499	0.7532	4
16-02A-1	0.2563	3.9300	23.1978	75.1085	4.0063	15.2351	99.9591	1.1062	
16-02A-2	0.2360	2.2831	60.7762	52.5930	3.6637	15.6523	99.9200	1.0978	
16-02A-3	0.2183	5.8181	693.8452	36.6036	3.3098	15.9762	99.1561	1.0871	
16-03A-1	0.2629	8.5861	43.4801	72.7639	3.6008	15.6482	99.9192	0.9702	
16-03A-2	0.2420	3.0837	108.3066	58.8709	3.3128	15.7911	99.8607	0.9699	
16-03A-3	0.2171	8.9104	58.2655	66.8588	2.8389	16.5502	99.9008	0.9239	
18-01A-1	0.1493	37.0121	82.4419	175.6140	2.0803	11.3517	99.7784	0.9809	
18-01A-2	0.2114	3.0993	43.8928	163.6898	2.9931	11.3517	99.9374	0.9995	
18-01A-3	0.2779	1.4435	19.9907	139.8434	3.8995	11.3517	99.9713	0.9943	
18-01A-4	0.3431	0.8752	10.7841	123.2819	4.8862	11.3517	99.9841	1.0133	
18-01A-5	0.3767	0.5304	9.2073	121.2000	5.3257	11.3517	99.9871	1.0082	
18-01A-6	0.1493	1.0029	34.1091	201.4433	2.1181	11.3517	99.9563	0.9971	
18-01A-7	0.2086	0.2865	21.0669	170.2694	2.8689	11.3328	99.9740	0.9698	
18-01A-8	0.3744	0.1464	8.0277	125.2696	5.3194	11.3422	99.9899	1.0131	
18-01A-9	0.2492	0.2599	17.6397	136.1167	3.6590	11.3422	99.9781	1.0384	
18-01A-10	0.3452	0.0144	9.3759	122.1431	5.2130	11.3517	99.9887	1.0745	
18-01A-11	0.3858	0.0387	8.3906	116.2950	5.8175	11.3517	99.9898	1.0760	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
26-01A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
26-02A-1	0.3700	0.0	5.6499	9.5283	4.7562	13.5384	99.9932	0.9163	
26-02A-2	0.3914	1.9002	6.6871	11.0322	5.0731	12.9409	99.9855	0.9253	
26-02A-3	0.4466	1.1262	7.0433	15.7372	5.7582	12.1964	99.9876	0.9237	
26-02A-4	0.4658	0.4529	5.9970	17.4967	6.0316	11.6737	99.9912	0.9290	
26-02A-5	0.4987	0.2641	5.9544	25.7557	6.5277	10.9597	99.9919	0.9410	
26-02A-6	0.4711	0.2236	5.9248	201.6274	6.6012	10.9202	99.9921	1.0055	
26-02A-7	0.4193	0.0	5.8218	164.8052	5.5936	12.0912	99.9930	0.9539	
26-02A-8	0.3634	0.0	5.7513	157.9502	5.0446	12.7922	99.9931	0.9888	
26-02A-9	0.4511	0.0	5.0221	31.6940	5.7346	12.0712	99.9939	0.9109	
26-02A-10	0.3921	0.0	4.4373	14.5504	5.0560	13.0336	99.9947	0.9203	
26-03A-1	0.3684	0.2141	7.0860	2.5828	4.3254	13.8395	99.9909	0.9530	
26-03A-2	0.2905	0.1810	8.3828	5.0441	3.0955	15.5813	99.9895	0.8608	
26-03A-3	0.3382	0.1555	7.7205	8.5462	3.5918	14.8931	99.9903	0.8606	
26-03A-4	0.3640	0.1444	7.6540	19.6712	4.0214	14.2398	99.9904	0.8965	
26-03A-5	0.2700	0.1947	9.6708	3.1385	2.7206	15.9708	99.9879	0.8131	
26-03A-6	0.3677	0.5013	8.4894	19.5362	5.6104	12.9384	99.9881	1.0874	
26-03A-7	0.3351	0.3926	8.7926	12.8256	4.9876	13.6410	99.9881	1.0584	
26-03A-8	0.2692	0.7829	50.5404	7.0370	4.1108	14.7206	99.9371	1.0823	
26-03A-9	0.2864	0.4594	7.8499	27.9338	4.8246	13.6979	99.9891	1.1940	
26-03A-10	0.4004	0.2628	4.7461	22.2043	4.8735	13.0524	99.9935	0.9901	
28-01A-1	0.1385	11.1341	449.8000	66.1097	1.9664	17.5345	99.4312	1.0076	
28-01A-2	0.2315	0.2346	30.9534	137.4263	3.3477	15.5398	99.9624	1.0216	
28-01A-3	0.2776	0.3915	14.1440	140.4987	4.0528	14.6602	99.9818	1.0343	
28-01A-4	0.3254	0.1670	9.2177	134.9428	4.7706	13.6442	99.9884	1.0420	
28-01A-5	0.3726	0.1458	8.6809	133.1124	5.5263	12.7111	99.9891	1.0573	
28-01A-6	0.4000	0.0	7.5033	119.2800	5.8429	12.2263	99.9910	1.0433	
28-01A-7	0.4347	0.0	7.4415	120.0808	6.5105	11.3960	99.9910	1.0722	
28-02A-1	0.1698	2.7363	84.7281	117.3736	2.4552	17.1402	99.8905	1.0187	
28-02A-2	0.2151	0.7167	44.1599	173.6205	3.2404	16.0674	99.9451	1.0637	
28-02A-3	0.2689	0.1908	16.3021	192.8215	4.0248	15.1248	99.9799	1.0599	
28-02A-4	0.3225	0.3184	7.8670	157.1159	4.8466	14.3170	99.9895	1.0678	
28-02A-5	0.3773	0.1360	7.3460	139.2699	5.6697	13.1605	99.9907	1.0715	
28-02A-6	0.4238	0.1211	6.5361	126.1451	6.3116	11.9692	99.9917	1.0654	
28-03A-1	0.1773	1.2970	33.2011	186.8305	2.5299	16.8150	99.9563	1.0045	
28-03A-2	0.2377	0.5368	14.8069	198.5863	3.4030	15.4519	99.9806	1.0294	
28-03A-3	0.2982	0.3421	6.2876	141.9957	4.2852	14.2479	99.9913	1.0192	
28-03A-4	0.3593	0.2839	5.8710	121.7067	5.2461	12.9260	99.9920	1.0398	
28-03A-5	0.4203	0.2427	10.0591	106.9056	6.1324	11.6879	99.9870	1.0435	
28-04A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
28-05A-1	0.1649	4.8403	28.8385	42.0846	1.3661	18.2824	99.9492	0.7983	
28-05A-2	0.2177	0.9386	14.1806	76.8695	1.9921	17.0864	99.9798	0.8841	
28-05A-3	0.2766	0.5537	10.3072	137.4354	2.6274	15.8164	99.9857	0.9205	
28-05A-4	0.3334	0.5361	7.8310	104.3337	3.2325	14.6459	99.9887	0.9424	
28-05A-5	0.3978	0.4493	8.9614	66.5133	4.0409	13.2243	99.9876	0.9911	
28-05A-6	0.1566	0.9777	27.1352	40.8382	1.4201	18.4358	99.9643	0.8731	
28-05A-7	0.1998	0.3829	12.9894	42.9415	1.6084	18.0804	99.9832	0.7769	
28-05A-8	0.2573	0.1982	11.9156	121.3982	2.4538	16.4127	99.9850	0.9233	
28-05A-9	0.3159	0.1614	5.9760	128.9243	3.1105	15.1845	99.9922	0.9561	
28-05A-10	0.3734	0.1365	6.3219	82.7218	3.8819	14.1019	99.9919	1.0129	
28-05A-11	0.4327	0.1178	5.4469	60.4100	4.4989	12.8581	99.9930	1.0162	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	COQ1	OXQ1	EFFGA	CFRAC	NOTE
28-05A-12	0.4619	0.0552	5.6221	56.7409	4.9289	12.0346	99.9930	1.0448	
28-05A-13	0.4915	0.0519	6.7225	59.2710	5.3216	11.2376	99.9916	1.0619	
28-05A-14	0.2002	0.2547	14.1543	43.2062	1.6248	17.8963	99.9822	0.7833	6
28-06A-1	0.1523	2.0150	18.5991	76.5561	1.4478	18.5196	99.9710	0.9148	
28-06A-2	0.1927	0.6621	19.6000	107.6463	1.8526	17.7560	99.9743	0.9274	
28-06A-3	0.2480	0.5144	11.4157	102.4242	2.4020	16.5546	99.9846	0.9370	
28-06A-4	0.3039	0.5039	6.2071	95.6382	2.9627	15.4714	99.9908	0.9460	
28-06A-5	0.3579	0.3565	5.2631	75.8933	3.4170	14.4972	99.9924	0.9292	
28-06A-6	0.4131	0.2470	6.2769	68.7055	4.1147	13.1507	99.9915	0.9725	
28-06A-7	0.4484	0.2845	5.2564	68.5790	4.5522	12.3525	99.9926	0.9932	
28-06A-8	0.3065	0.3329	6.9150	90.6191	2.9379	15.1028	99.9905	0.9303	
28-07A-1	0.1518	1.0089	21.9315	56.5995	1.5168	18.5314	99.9704	0.9618	
28-07A-2	0.1965	0.3893	15.7089	66.8243	1.7940	17.9774	99.9799	0.8809	
28-07A-3	0.2524	0.3031	11.2857	111.9123	2.4869	16.6609	99.9854	0.9534	
28-07A-4	0.3091	0.1649	8.4467	134.5797	3.1638	15.4048	99.9893	0.9936	
28-07A-5	0.3655	0.0697	5.8508	94.2696	3.6429	14.5790	99.9927	0.9704	
28-07A-6	0.4214	0.0605	5.6361	69.5986	4.3937	13.2870	99.9930	1.0185	
28-07A-7	0.4465	0.0571	5.8475	63.8591	4.8256	12.4425	99.9927	1.0572	
28-07A-8	0.4347	0.0586	6.0019	65.4358	4.5493	12.8788	99.9925	1.0230	
28-07A-9	0.1980	0.1287	14.3869	56.1294	1.8816	17.5536	99.9823	0.9168	
29-01A-1	0.3242	4.0794	26.4046	45.9815	4.5292	14.4882	99.9546	0.9932	
29-01A-2	0.4038	1.9768	15.3004	62.9007	5.7268	12.8404	99.9748	1.0133	
29-01A-3	0.2448	0.9396	36.9824	39.6260	3.3471	16.1360	99.9528	0.9673	
29-01A-4	0.1832	0.9756	233.1367	36.1552	2.4845	17.2607	99.7204	0.9601	
29-02A-1	0.2490	3.1435	44.3408	44.3744	3.5453	15.7510	99.9366	1.0078	
29-02A-2	0.1879	0.5509	249.2468	47.0493	2.5958	17.0624	99.7027	0.9788	
29-02A-3	0.1482	0.8733	1002.9534	88.1935	2.0340	17.8805	98.8113	0.9883	
29-02A-4	0.1055	1.2270	231.2504	228.6371	1.5545	18.6403	99.7233	1.0373	
29-02A-5	0.0779	3.3266	63.0991	315.5171	1.2686	19.2026	99.9146	1.1390	
29-02A-6	0.3040	0.5110	18.5080	48.4353	4.3973	14.7379	99.9762	1.0268	
29-02A-7	0.3616	0.4297	23.9999	59.4197	5.2268	13.5083	99.9697	1.0302	
29-02A-8	0.2491	1.0408	44.3508	109.2500	3.4854	15.6114	99.9437	0.9902	
29-02A-9	0.3081	0.7570	21.3157	123.3212	4.3622	14.5103	99.9720	1.0053	
29-02A-10	0.1893	1.6448	242.3974	76.8305	2.4964	16.8491	99.7071	0.9347	
29-02A-11	0.1266	2.6646	891.1663	157.1353	1.8117	17.8008	98.9390	1.0252	
29-02A-12	0.0778	4.6686	57.1396	415.0659	1.2474	18.6901	99.9172	1.1212	
29-02A-13	0.0544	9.5568	42.9879	159.3452	0.8339	19.5495	99.9176	1.0701	
29-02A-14	0.1303	2.9879	1033.8000	120.9178	1.8990	18.0237	98.7692	1.0471	
29-03A-1	0.2104	6.9532	149.2640	56.1647	3.0895	16.7479	99.7994	1.0388	
29-03A-2	0.2686	1.0325	20.0717	53.1084	4.0877	15.4815	99.9726	1.0777	
29-03A-3	0.3079	0.6543	12.9201	44.6859	4.7054	14.5795	99.9823	1.0848	
29-03A-4	0.3465	0.0	9.4505	50.8310	5.3053	0.0	99.9887	1.0895	
29-03A-5	0.0855	4.1327	927.4634	243.1948	1.5346	18.9240	98.8943	1.2775	6
29-03A-6	0.1270	2.5825	857.6589	38.6875	2.0575	18.2857	98.9788	1.1568	6
29-03A-7	0.1712	2.0646	259.1831	40.8521	2.6409	17.5066	99.6861	1.0913	
29-03A-8	0.0538	8.9249	26.0568	125.6561	0.9589	19.8628	99.9397	1.2432	
29-03A-9	0.1895	1.8651	195.1859	42.7342	2.8570	17.3630	99.7623	1.0664	
29-03A-10	0.1913	2.1126	186.9313	144.1582	2.6031	16.8504	99.7712	0.9627	
29-03A-11	0.2286	1.1022	55.6063	162.7161	3.2246	15.9874	99.9302	0.9969	
29-03A-12	0.2656	0.6633	11.4617	180.3406	3.8390	15.2693	99.9841	1.0229	
29-03A-13	0.3057	0.5764	9.1868	188.8982	4.4329	14.4694	99.9871	1.0292	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-03A-14	0.3474	0.5798	7.4080	186.4754	5.0634	13.5045	99.9892	1.0372	
29-03A-15	0.1397	1.9853	752.3704	152.8863	1.9240	17.6848	99.1043	0.9850	
29-03A-16	0.1067	3.3105	1171.6365	145.1217	1.6227	18.1909	98.6076	1.0932	
29-03A-17	0.0790	4.7947	1348.9397	85.0627	1.2811	18.7278	98.3967	1.1664	3
29-03A-18	0.0551	7.7950	1029.8413	97.6999	0.9340	19.2458	98.7642	1.2076	3
29-04A-1	0.0911	3.7531	38.3085	143.3545	1.3676	18.7429	99.9423	1.0503	
29-04A-2	0.1265	1.8702	161.6759	280.2766	1.7688	18.1383	99.8029	0.9842	
29-04A-3	0.1635	0.6422	406.5276	183.8424	2.2928	17.3452	99.5167	0.9956	
29-04A-4	0.1269	4.5718	287.7788	322.1521	1.8560	17.6765	99.6449	1.0322	
29-04A-5	0.1729	1.5209	283.3528	99.1795	2.5296	16.8446	99.6593	1.0360	
29-04A-6	0.2098	0.7512	65.7969	37.1603	3.0184	16.3335	99.9193	1.0160	
29-04A-7	0.2475	0.4243	11.2669	42.4429	3.6347	15.2203	99.9852	1.0383	
29-04A-8	0.2873	0.1827	8.0800	44.9991	4.2554	14.4635	99.9897	1.0499	
29-04A-9	0.3220	0.1630	7.9423	49.5834	4.7605	13.8217	99.9899	1.0504	
29-05A-1	0.0868	3.1965	48.5469	111.1477	1.3457	18.6362	99.9322	1.0856	
29-05A-2	0.1289	1.9545	209.7853	257.3381	1.9119	17.8456	99.7457	1.0448	
29-05A-3	0.1735	0.6703	321.5920	202.3936	2.4893	17.1615	99.6162	1.0171	
29-05A-4	0.2108	0.4771	47.9136	46.2149	3.1391	16.3475	99.9415	1.0511	
29-05A-5	0.2483	0.3036	11.2878	37.0343	3.7030	15.4842	99.9855	1.0542	
29-05A-6	0.2861	0.1756	8.9790	41.6733	4.3487	14.7114	99.9887	1.0771	
29-05A-7	0.3244	0.0774	8.6353	41.7019	4.9594	14.0570	99.9894	1.0863	
29-05A-8	0.3647	0.0689	8.3274	43.2203	5.5216	13.3072	99.9898	1.0786	
29-05A-9	0.2258	0.1113	24.8766	42.0546	3.3640	15.8833	99.9700	1.0521	
29-06A-1	0.1265	11.5665	202.2350	258.7966	1.8179	18.1551	99.7225	1.0126	
29-06A-2	0.1706	4.9191	410.8528	188.5797	2.3204	17.4894	99.4970	0.9666	
29-06A-3	0.2076	2.9295	100.1094	47.2148	2.8893	16.7429	99.8713	0.9835	
29-06A-4	0.2442	1.0318	30.7013	32.4906	3.5129	15.8677	99.9600	1.0171	
29-06A-5	0.2825	0.2669	15.2190	35.9678	4.0373	15.1536	99.9833	1.0127	
29-06A-6	0.3216	0.0781	7.9837	39.1268	4.6760	14.2994	99.9902	1.0330	
29-06A-7	0.1297	9.2643	203.8272	381.8643	1.6834	18.0044	99.7283	1.0231	
29-06A-8	0.1749	5.9812	326.2666	182.5103	2.3945	17.1902	99.5935	0.9712	
29-06A-9	0.2123	6.5207	71.6827	63.5196	2.9727	16.2977	99.8929	0.9890	
29-06A-10	0.2497	1.9245	31.7528	74.4304	3.5147	15.8124	99.9557	0.9958	
29-06A-11	0.2889	0.6973	12.0713	134.4931	4.1129	15.1201	99.9832	1.0093	
29-06A-12	0.3261	0.3857	11.4009	148.8790	4.6275	14.3497	99.9850	1.0086	
29-06A-13	0.3663	0.2058	19.0844	156.2809	5.1910	13.5144	99.9764	1.0100	
29-06A-14	0.2285	0.1099	18.3191	56.2564	3.2562	15.9788	99.9778	1.0061	
29-06A-15	0.1917	0.3934	106.7480	69.2739	2.7392	16.6998	99.8721	1.0090	
29-06A-16	0.2388	0.4212	11.6782	91.2923	3.4063	15.7255	99.9847	1.0079	
29-06A-17	0.1071	1.6447	153.2401	398.5889	1.6527	18.2006	99.8138	1.0838	
29-06A-18	0.2473	0.3049	13.1492	94.4919	3.5013	15.7044	99.9833	1.0009	
29-07A-1	0.1767	4.3698	200.0731	205.1475	2.3594	17.4379	99.7483	0.9441	
29-07A-2	0.2144	1.0727	63.2425	139.6262	2.9065	16.6547	99.9213	0.9577	
29-07A-3	0.2484	0.3079	18.7191	101.4028	3.4042	15.8351	99.9767	0.9690	
29-07A-4	0.2902	0.4397	12.0100	104.0867	4.0405	15.1626	99.9842	0.9873	
29-07A-5	0.3488	0.0	9.3294	150.0982	4.9877	13.9026	99.9888	1.0177	
29-08A-1	0.1729	1.0337	625.2842	80.7348	2.3015	17.4884	99.2560	0.9515	
29-08A-2	0.2096	0.3650	76.2760	40.6922	2.8389	16.6588	99.9058	0.9568	
29-08A-3	0.2484	0.2052	19.6721	106.0988	3.3850	15.8911	99.9759	0.9636	
29-08A-4	0.2862	0.0891	14.6185	125.3063	3.9353	15.1454	99.9822	0.9747	
29-08A-5	0.3297	0.2320	12.6887	135.2291	4.4916	14.1633	99.9840	0.9684	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-08A-6	0.2290	0.1113	26.4278	51.4015	3.1534	16.0749	99.9682	0.9728	
29-08A-7	0.1270	0.6023	772.6121	193.4021	1.8856	17.6675	99.0858	1.0598	
29-08A-8	0.0869	1.1735	40.1116	313.2791	1.3315	18.8430	99.9489	1.0717	
29-09A-1	0.1715	0.8927	872.9011	33.9109	2.3440	17.6368	98.9633	0.9824	
29-09A-2	0.2105	0.1211	76.8600	32.1749	3.0091	16.7865	99.9083	1.0097	
29-09A-3	0.2469	0.1024	14.0027	40.0974	3.5993	15.9090	99.9830	1.0226	
29-09A-4	0.2877	0.0886	10.4941	44.8545	4.2507	14.8785	99.9872	1.0473	
29-09A-5	0.3270	0.1559	18.5150	42.3677	4.7927	14.1367	99.9773	1.0418	
29-09A-6	0.1704	0.5987	118.5791	314.3584	2.3183	17.2963	99.8576	0.9595	
29-09A-7	0.1968	0.1262	146.0819	170.6027	2.8730	16.5740	99.8262	1.0214	
29-09A-8	0.2553	0.0998	29.2033	36.0288	3.4600	15.8569	99.9649	0.9592	
29-09A-9	0.2795	0.0912	9.9761	31.0659	3.9954	15.1032	99.9878	1.0127	
29-09A-10	0.3172	0.1607	7.3245	27.1631	4.5855	14.4708	99.9907	1.0268	
29-09A-11	0.3550	0.0718	7.1895	29.4539	5.1467	13.6017	99.9911	1.0323	
29-09A-12	0.2520	0.2023	24.0143	58.4974	3.4872	15.6050	99.9707	0.9790	
29-09A-13	0.2912	0.0875	10.3740	57.8222	4.0895	14.8201	99.9873	0.9956	
29-09A-14	0.3321	0.2304	8.3972	88.2461	4.7050	14.0659	99.9892	1.0073	
29-09A-15	0.3722	0.0685	7.4926	127.1407	5.2686	13.2646	99.9908	1.0092	
29-09A-16	0.2196	0.4646	106.3004	117.2765	3.0165	16.0462	99.8721	0.9717	
29-09A-17	0.1877	0.2716	235.3948	403.9998	2.5232	16.7011	99.7200	0.9522	
29-09A-18	0.1385	0.3681	33.6283	197.0963	1.8738	17.5739	99.9590	0.9501	
29-09A-19	0.1041	0.7350	15.6070	157.9154	1.4025	18.3246	99.9791	0.9436	
29-09A-20	0.2052	0.1242	125.3706	441.9414	2.8393	16.6375	99.8508	0.9784	
29-09A-21	0.2802	0.1820	9.1093	84.6978	3.9368	14.9575	99.9885	0.9960	
29-09A-22	0.3197	0.0797	7.2658	45.4611	4.3590	14.2105	99.9910	1.0129	
29-09A-23	0.3586	0.2133	6.4776	99.7827	5.1256	13.2347	99.9915	1.0179	
29-09A-24	0.2995	0.0851	6.2039	56.4617	4.3119	14.1603	99.9923	1.0214	
29-10A-1	0.1477	4.5261	1032.6794	15.8770	2.0683	17.3541	98.7639	1.0089	
29-10A-2	0.1814	1.6920	105.2785	24.3897	2.5395	16.6931	99.8696	0.9876	
29-10A-3	0.2154	0.7108	39.1203	32.8604	3.0873	15.9688	99.9511	1.0115	
29-10A-4	0.2490	0.5124	29.1478	37.4586	3.5704	15.3421	99.9636	1.0143	
29-10A-5	0.2826	0.3611	15.6999	36.9460	4.0496	14.7777	99.9800	1.0157	
29-10A-6	0.1673	5.7059	623.5610	36.0134	2.3112	17.5040	99.2426	0.9865	
29-10A-7	0.2042	3.7823	69.0612	31.1341	2.8539	16.7642	99.9053	0.9868	
29-10A-8	0.2374	0.8608	25.6019	38.2702	3.4829	16.0020	99.9666	1.0369	
29-10A-9	0.2733	0.3733	17.9583	38.4759	3.9216	15.3421	99.9773	1.0163	
29-10A-10	0.3197	0.2393	21.2319	40.1464	4.6235	14.4152	99.9738	1.0278	
29-10A-11	0.2578	0.1977	11.7718	41.0546	3.6310	15.6151	99.9853	0.9964	
29-10A-12	0.2923	0.1744	8.7825	43.9036	4.2138	14.9571	99.9889	1.0222	
29-10A-13	0.3339	0.0763	9.7969	47.1988	4.7983	14.2491	99.9880	1.0219	
29-10A-14	0.2065	0.1234	22.6322	36.3714	2.9569	16.3325	99.9727	1.0097	
29-10A-15	0.1716	0.2972	136.5424	39.0500	2.4672	17.0764	99.8373	1.0146	
29-10A-16	0.2352	0.2167	19.8691	40.6619	3.3530	15.8045	99.9756	1.0070	
29-10A-17	0.2682	0.0950	7.8351	33.1033	3.9301	15.0073	99.9903	1.0374	
29-10A-18	0.3090	0.1650	6.7942	38.2187	4.5459	14.3202	99.9913	1.0441	
29-10A-19	0.1905	0.2676	84.0354	105.9131	2.7640	16.4596	99.8995	1.0234	
29-10A-20	0.2508	0.2033	12.1008	54.9954	3.4963	15.6992	99.9849	0.9858	
29-10A-21	0.2957	0.1724	7.1054	64.5126	4.1474	14.9237	99.9909	0.9946	
29-10A-22	0.3393	0.2255	6.1795	116.6336	4.7672	14.1218	99.9918	0.9993	
29-10A-23	0.2337	0.3273	18.9842	61.9390	3.2406	16.1632	99.9763	0.9796	
29-10A-24	0.2123	0.3603	53.0236	86.1096	2.9156	16.5021	99.9356	0.9695	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	MCQ15	CMQ15	NXCQ15	COQ1	OXQ1	EFFGA	CFRAC	NOTE
29-10A-25	0.1269	1.4082	36.8250	321.8391	1.7780	18.1551	99.9518	0.9829	
29-10A-26	0.1496	1.1950	70.5869	0.0	2.1107	17.6460	99.9125	0.9925	
29-10A-27	0.2025	0.2517	32.3492	57.4128	2.8662	16.6792	99.9608	0.9979	
29-10A-28	0.2113	0.2413	14.3629	44.6528	2.9902	16.6155	99.9821	0.9981	
29-10A-29	0.2430	0.3148	9.5962	86.0063	3.4370	16.1075	99.9875	0.9996	
29-10A-30	0.2504	0.3055	9.3173	42.5501	3.5346	16.0020	99.9879	0.9979	
29-11A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-11B-1	0.3567	0.2144	6.5413	76.0385	5.2571	13.7850	99.9914	1.0495	
29-11B-2	0.3639	0.1401	6.4126	65.5804	5.4653	13.7638	99.9918	1.0701	
29-12A-1	0.2685	0.0949	7.8226	52.8228	4.0068	15.2049	99.9903	1.0566	
29-12A-2	0.2847	0.1791	7.3807	55.6165	4.0296	14.6036	99.9906	1.0030	
29-12A-3	0.3018	0.0844	6.9579	60.9529	4.5367	14.5177	99.9914	1.0665	
29-12A-4	0.3246	0.2356	7.1886	65.3005	4.8922	14.3162	99.9906	1.0708	
29-12A-5	0.2578	0.0989	8.1451	44.5471	3.7866	15.5206	99.9900	1.0389	
29-12A-6	0.3015	0.1691	6.9659	87.1258	4.2835	14.6276	99.9911	1.0081	
29-12A-7	0.2830	0.0901	7.4211	69.9849	4.0125	15.1223	99.9908	1.0048	
29-12A-8	0.2683	0.1900	7.8272	56.0818	3.8006	15.4122	99.9900	1.0028	
29-12A-9	0.2527	0.3027	7.3898	40.7829	3.5759	15.5552	99.9902	1.0005	
29-12A-10	0.3478	0.0733	7.3880	59.5569	4.9595	13.9449	99.9909	1.0149	
29-13A-1	0.1687	0.7564	953.5278	61.5520	2.0076	17.9073	98.8685	0.8604	
29-13A-2	0.2073	0.3689	547.2817	53.6187	2.6010	17.0241	99.3491	0.8977	
29-13A-3	0.2946	0.1730	55.9630	52.2923	4.0011	14.8299	99.9326	0.9643	
29-13B-1	0.2452	0.1039	112.4024	49.1385	3.2382	16.0586	99.8659	0.9359	
29-13B-2	0.2117	0.2408	251.8937	46.6416	2.7621	16.6281	99.7001	0.9262	
29-13B-3	0.1708	0.4479	756.0449	46.7356	2.2359	17.5947	99.1032	0.9391	
29-13B-4	0.1275	1.2012	1454.8977	44.7021	1.7015	18.4525	98.2783	0.9715	
29-13B-5	0.1009	1.7722	1141.3259	109.2586	1.2504	19.0556	98.6490	0.8957	
29-13B-6	0.1754	0.5817	820.6501	82.0291	2.1485	17.7251	99.0260	0.8819	
29-13B-7	0.0894	1.7138	693.8450	239.7440	1.2211	19.2495	99.1772	0.9726	
29-13B-8	0.1295	0.9848	1648.1392	71.7603	1.6613	18.4523	98.0506	0.9398	
29-13B-9	0.2188	0.1165	267.5630	119.3177	2.7875	16.6763	99.6817	0.9054	
29-13B-10	0.2597	0.1963	150.4913	149.3294	3.2832	15.8142	99.8201	0.8979	
29-14A-1	0.2305	0.3319	94.6536	37.5126	3.1473	16.1701	99.8863	0.9663	
29-14A-2	0.1861	0.4110	493.5642	50.0240	2.5126	17.0228	99.4136	0.9625	
29-14A-3	0.1647	0.4644	998.4626	55.1746	2.2248	17.4077	98.8166	0.9741	
29-14A-4	0.1271	0.8027	1066.3806	236.0867	1.7407	18.1230	98.7383	0.9864	
29-14A-5	0.2579	0.0988	56.0583	37.6008	3.5237	15.4382	99.9329	0.9676	
29-14A-6	0.1436	0.7105	1430.2168	120.4579	1.8251	18.5522	98.3072	0.9273	
29-14A-7	0.1735	0.4410	1106.8059	54.8508	2.2439	17.8861	98.6877	0.9370	
29-14A-8	0.2124	0.3602	261.2544	88.2490	2.7809	16.9776	99.6886	0.9298	
29-14A-9	0.2552	0.1998	97.6361	117.1778	3.3874	15.9123	99.8830	0.9412	
29-14A-10	0.1822	0.4199	660.5312	68.2953	2.3400	17.6461	99.2158	0.9202	
29-14A-11	0.2138	0.2385	158.2401	67.0206	2.8840	16.8706	99.8113	0.9553	
29-14A-12	0.2526	0.2018	101.9281	94.2860	3.4145	16.1427	99.8779	0.9582	
29-15A-1	0.1647	0.6193	416.2761	246.3602	2.2767	17.7423	99.5052	0.9816	
29-15A-2	0.2027	0.1257	104.2248	81.4564	2.9053	17.0086	99.8759	1.0124	
29-15A-3	0.2396	0.2128	47.5820	40.4073	3.4607	16.2234	99.9427	1.0216	
29-15A-4	0.2764	0.0922	36.2281	35.1700	4.0107	15.5044	99.9565	1.0283	
29-15A-5	0.3142	0.2435	29.9645	37.4243	4.5624	14.7799	99.9633	1.0317	
29-15A-6	0.2109	0.1208	103.1030	73.3909	2.9985	16.8649	99.8772	1.0048	
29-15A-7	0.2500	0.2039	45.5932	79.7614	3.5753	16.1032	99.9450	1.0120	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-15A-8	0.1924	0.3975	145.6699	107.5190	2.6780	17.2633	99.8259	0.9835	
29-15A-9	0.2898	0.1759	35.8979	106.2993	4.1277	15.2840	99.9565	1.0103	
29-15A-10	0.1811	0.1408	287.7146	116.4704	2.4552	17.4677	99.6586	0.9612	
29-15A-11	0.1792	0.2845	349.8611	59.3954	2.4177	17.7411	99.5845	0.9579	
29-15A-12	0.2166	0.1177	141.0826	97.4357	3.0089	16.9692	99.8320	0.9834	
29-15A-13	0.2558	0.0996	67.3847	122.0240	3.5862	16.2059	99.9194	0.9931	
29-15A-14	0.1461	0.6983	477.4543	220.4459	1.9778	18.4293	99.4332	0.9619	
29-15A-15	0.1450	0.8798	679.9609	127.0149	1.9546	18.5909	99.1933	0.9629	
29-15A-16	0.1365	0.9350	578.3193	255.6907	1.8392	18.6602	99.3137	0.9598	
29-15A-17	0.1779	0.4301	441.2771	60.5967	2.3932	17.7639	99.4758	0.9575	
29-15A-18	0.2111	0.2415	106.9258	74.2839	2.9259	17.1727	99.8722	0.9797	
29-15A-19	0.2495	0.1022	65.8364	112.9292	3.5097	16.1389	99.9213	0.9961	
29-16A-1	0.2331	0.1093	11.0723	57.8496	3.3880	16.2816	99.9865	1.0266	
29-16A-2	0.2762	0.2770	6.7881	44.3221	4.1091	15.4953	99.9910	1.0537	
29-16A-3	0.3163	0.1612	4.4478	46.7747	4.7428	14.6177	99.9941	1.0648	
29-16A-4	0.1426	0.7157	126.2157	382.7024	2.0791	18.1454	99.8484	1.0266	
29-16A-5	0.2067	0.1233	61.6507	150.6705	2.8590	17.1477	99.9264	0.9764	
29-16A-6	0.2487	0.3076	9.4250	65.0095	3.5217	16.3586	99.9877	1.0010	
29-16A-7	0.2959	0.1723	4.7515	91.5705	4.2455	15.4015	99.9937	1.0176	
29-16A-8	0.2055	0.1240	62.0084	59.2173	2.8416	17.2612	99.9260	0.9760	
29-16A-9	0.1540	0.6624	1195.6018	61.4075	2.0823	18.3755	98.5837	0.9790	
29-16A-10	0.1593	0.4802	668.2061	138.7939	2.1781	18.3063	99.2078	0.9772	
29-16A-11	0.1934	0.9240	102.9340	42.5098	2.7875	17.4058	99.8748	1.0173	
29-17A-1	0.2131	0.8389	59.1228	136.6109	2.9053	16.7393	99.9270	0.9630	
29-17A-2	0.2523	0.2021	17.4634	56.8023	3.4340	16.0807	99.9785	0.9628	
29-17A-3	0.2913	0.0875	12.7303	41.2571	3.9727	15.2874	99.9845	0.9670	
29-17A-4	0.3208	0.1589	8.6630	45.7218	4.5963	13.5433	99.9891	1.0177	
29-17A-5	0.2209	0.3463	37.9046	81.1526	2.9259	15.8643	99.9538	0.9355	
29-17A-6	0.2574	0.0990	15.3122	79.3655	3.4503	15.2558	99.9814	0.9485	
29-17A-7	0.2366	0.2153	22.5385	73.9795	3.1451	15.4705	99.9725	0.9386	
29-17A-8	0.1785	0.1428	247.1499	74.1658	2.4035	16.4545	99.7067	0.9535	
29-17A-9	0.1322	0.5785	357.7727	416.1387	1.8052	17.2711	99.5755	0.9661	
29-17A-10	0.1277	0.3991	1282.6392	76.9317	1.7329	17.5513	98.4843	0.9827	
29-17A-11	0.1071	1.1915	1201.9917	58.6521	1.3306	18.4544	98.5789	0.8996	
29-18A-1	0.2107	2.6804	213.3385	172.2992	2.8271	16.2705	99.7377	0.9514	
29-18A-2	0.2621	1.5636	170.2735	60.3638	3.5919	15.5757	99.7918	0.9738	
29-18A-3	0.2714	1.6998	163.9585	49.2870	3.7247	14.9239	99.7988	0.9756	
29-18A-4	0.2905	1.4110	31.2708	59.1369	4.0071	14.4426	99.9579	0.9787	
29-18A-5	0.2641	0.1931	49.4434	52.2062	3.6289	14.9739	99.9404	0.9736	
29-18A-6	0.2311	0.1103	105.0293	66.1685	3.1377	15.5619	99.8747	0.9612	
29-18A-7	0.1943	0.2624	352.9346	156.9505	2.5675	16.2014	99.5805	0.9393	
29-18A-8	0.1948	0.2617	427.7236	61.2571	2.5724	16.1828	99.4918	0.9405	
29-18A-9	0.1937	0.1315	399.5088	47.5371	2.5557	16.2014	99.5258	0.9388	
29-18A-10	0.1931	0.3961	412.1321	37.0930	2.5459	16.1963	99.5099	0.9385	
29-18A-11	0.1264	0.4032	461.5540	290.7981	1.6642	17.2653	99.4538	0.9340	
29-18A-12	0.1249	0.2041	1368.3330	66.0711	1.6065	17.3167	98.3841	0.9354	
29-18A-13	0.1250	0.2039	1101.4355	40.9015	1.6203	17.3253	98.6991	0.9359	
29-18A-14	0.1227	0.4155	114.5714	231.6617	1.6353	17.3815	99.8634	0.9369	
29-18A-15	0.1935	0.3954	292.9028	199.9137	2.5576	16.2401	99.6513	0.9382	
29-18A-16	0.2362	0.1079	103.6570	67.5318	3.2099	15.4372	99.8763	0.9625	
29-18A-17	0.2357	0.1081	109.1587	57.8702	3.1996	15.4187	99.8698	0.9613	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-18A-18	0.2359	0.2161	102.0225	48.6096	3.1996	15.4372	99.8779	0.9605	
29-19A-1	0.2052	0.0	0.0	126.3415	3.0148	16.0018	-	-	
29-19A-2	0.2054	0.0	0.0	89.9704	2.9153	16.1275	-	-	
29-19A-3	0.2073	0.0	0.0	59.5441	2.9791	15.9910	-	-	
29-19A-4	0.2067	0.0	0.0	56.0497	2.9588	15.9027	-	-	
29-19A-5	0.2498	0.1020	0.0	58.7016	3.6383	15.0263	99.9996	1.0295	
29-19A-6	0.1732	0.4416	0.0	273.1143	2.5631	16.3607	99.9985	1.0406	
29-19A-7	0.1756	0.1451	0.0	56.2061	2.5600	16.3607	99.9995	1.0252	
29-19A-8	0.1302	0.3915	0.0	65.2516	2.0106	16.9790	99.9987	1.0826	
29-19A-9	0.1741	2.0584	58.2124	324.2874	2.4063	16.9360	99.9241	0.9735	
29-19A-10	0.1743	0.4389	70.2549	66.9008	2.4425	16.8661	99.9153	0.9873	
29-19A-11	0.1744	0.8782	59.5316	64.5155	2.4573	16.7308	99.9265	0.9925	
29-19A-12	0.1741	1.0266	62.2555	57.1439	2.4884	16.6935	99.9228	1.0067	
29-19A-13	0.2080	0.0	30.9585	120.7095	3.0117	16.0072	99.9632	1.0213	
29-19A-14	0.2099	0.0	28.4533	55.8684	3.0764	15.9137	99.9662	1.0338	
29-19A-15	0.2491	0.0	23.9821	57.5098	3.6493	15.1828	99.9715	1.0362	
29-19A-16	0.0864	2.3660	85.2784	248.4707	1.4136	18.0708	99.8917	1.1464	
29-19A-17	0.0905	1.1276	405.4734	65.9582	1.4444	18.0373	99.5187	1.1263	
29-19A-18	0.1255	0.6097	71.5814	309.6138	1.8948	17.5053	99.9135	1.0604	
29-19A-19	0.1282	0.3977	172.3790	89.8532	1.9043	17.5094	99.7951	1.0456	
29-19A-20	0.1283	0.3974	130.0294	57.7677	1.8996	17.5466	99.8451	1.0414	
29-19A-21	0.1258	1.5785	48.2286	288.6685	1.8548	17.3811	99.9378	1.0346	
29-19A-22	0.1693	0.5854	66.3890	296.1465	2.4204	16.6381	99.9194	1.0065	
29-19A-23	0.2077	0.1192	31.4679	117.9515	2.9537	15.9246	99.9622	1.0031	
29-19A-24	0.2457	0.0	18.9805	56.0854	3.4672	15.1951	99.9774	0.9978	
29-19A-25	0.0902	1.0991	36.1546	225.1599	1.3848	17.7071	99.9538	1.0745	
29-19A-26	0.0908	1.0911	77.1167	343.0281	1.3712	17.6847	99.9055	1.0574	
29-19A-27	0.1275	0.5829	283.9949	124.0555	1.8595	17.0151	99.6628	1.0294	
29-19A-28	0.1756	0.0	53.2348	48.8351	2.4285	16.3063	99.9369	0.9738	
29-19A-29	0.2091	0.0	26.7735	111.6615	2.9537	15.5838	99.9682	0.9963	
29-19A-30	0.0947	1.0468	897.5774	109.3132	1.3803	17.4996	98.9392	1.0416	
29-19A-31	0.1276	0.5822	258.8459	58.5804	1.8595	16.8194	99.6924	1.0276	
29-19A-32	0.1075	0.6912	694.7998	73.3433	1.5349	17.3104	99.1785	1.0166	
29-19A-33	0.1496	0.3311	106.7466	96.1985	2.1460	16.4968	99.8727	1.0099	
29-19A-34	0.1343	0.9229	55.6547	548.9395	2.0391	16.9597	99.9312	1.0662	
29-19A-35	0.1350	0.5505	102.6276	64.8408	2.1314	16.8101	99.8769	1.1100	
29-19A-36	0.1522	0.3253	53.7286	49.1311	2.4107	16.5155	99.9354	1.1132	
29-19A-37	0.1810	0.1367	34.8093	38.6673	2.7521	16.1035	99.9583	1.0704	
29-19A-38	0.2258	0.0	18.5798	117.7662	3.4382	15.1644	99.9779	1.0751	
29-19A-39	0.2200	0.0	19.0590	43.9898	3.2434	15.4148	99.9774	1.0407	
29-19A-40	0.1933	0.0	24.1016	41.8935	3.1096	15.5405	99.9714	1.1333	
29-19A-41	0.1587	0.0	38.2179	102.7323	2.5563	16.1785	99.9548	1.1329	
29-19A-42	0.2109	0.0	22.1057	46.5168	3.2147	15.4841	99.9737	1.0750	
29-19A-43	0.2584	0.0	15.3177	64.1132	3.5092	15.0828	99.9818	0.9608	
29-19A-44	0.2459	0.0	16.0994	68.5015	3.4402	15.2085	99.9808	0.9908	
29-19A-45	0.2075	0.0	17.9547	39.0400	2.9567	15.7489	99.9787	1.0049	
29-20A-1	0.1250	0.8260	42.4291	262.7715	1.8112	17.4987	99.9471	1.0167	
29-20A-2	0.1656	0.0	36.9863	244.7462	2.2983	16.8531	99.9538	0.9762	
29-20A-3	0.2052	0.2521	28.0645	196.5756	2.8678	16.1304	99.9658	0.9856	
29-20A-4	0.2424	0.3201	14.2474	130.2871	3.4221	15.3942	99.9820	0.9977	
29-20A-5	0.2808	0.2764	10.6495	125.2866	3.9847	14.5986	99.9864	1.0055	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-20A-6	0.1261	0.6156	45.7156	107.6663	1.8300	17.1857	99.9440	1.0187	
29-20A-7	0.1603	0.4842	40.2908	129.5552	2.2740	16.6146	99.9507	0.9976	
29-20A-8	0.1965	0.2632	28.1738	125.2683	2.7572	15.9991	99.9657	0.9891	
29-20A-9	0.2317	0.3349	13.8908	75.0186	3.2870	15.3179	99.9823	1.0019	
29-20A-10	0.2696	0.2879	11.0928	61.7148	3.8183	14.6491	99.9858	1.0029	
29-20A-11	0.2876	0.2698	9.6018	66.5749	4.0821	14.3550	99.9876	1.0061	
29-21A-1	0.0903	1.4330	69.0376	284.6816	1.4365	18.5379	99.9139	1.1139	
29-21A-2	0.1345	1.3479	94.9125	341.5681	1.9243	17.6463	99.8834	1.0058	
29-21A-3	0.1798	0.1438	25.6537	83.4769	2.5531	16.7150	99.9691	0.9996	
29-21A-4	0.2177	0.0	20.1217	113.9746	3.1272	15.9915	99.9761	1.0135	
29-21A-5	0.1827	0.4247	23.9743	66.8223	2.6175	16.6008	99.9702	1.0085	
29-21A-6	0.1610	0.8038	32.9621	75.7129	2.3324	16.9432	99.9583	1.0186	
29-21A-7	0.1333	0.9711	65.9814	97.2613	2.0145	17.2093	99.9188	1.0618	
29-21A-8	0.1977	0.3925	22.1598	147.9374	2.8779	16.6388	99.9724	1.0259	
29-21A-9	0.1119	0.0	194.1685	120.0390	1.6805	18.0259	99.7710	1.0561	
29-21A-10	0.0689	0.3752	164.8489	296.4585	1.1614	18.6706	99.8049	1.1807	3
29-21A-11	0.0901	0.5743	199.2385	80.7335	1.3865	18.3673	99.7634	1.0813	
29-21A-12	0.1106	0.7016	117.5299	106.0059	1.6852	18.0259	99.8591	1.0697	
29-21A-13	0.1361	0.7605	80.0420	152.0840	2.0766	17.5323	99.9029	1.0723	
29-21A-14	0.1616	0.6405	61.6310	170.5880	2.3811	17.0953	99.9249	1.0370	
29-21A-15	0.1856	0.2787	64.9987	181.6533	2.7522	16.6579	99.9220	1.0453	
29-22A-1	0.1467	1.7918	108.3639	236.1156	2.0121	16.9208	99.8659	0.9652	
29-22A-2	0.1751	1.2004	94.7524	209.6191	2.4139	16.4832	99.8837	0.9718	
29-22A-3	0.2072	0.8874	46.8632	170.0902	2.8927	15.8237	99.9414	0.9851	
29-22A-4	0.2388	0.6599	25.4653	149.8398	3.3396	18.9913	99.9675	0.9885	
29-22A-5	0.2703	0.5830	16.6265	146.8967	3.7615	14.7979	99.9782	0.9855	
29-22A-6	0.1114	2.1240	68.8058	231.0501	1.6216	17.3621	99.9117	1.0212	
29-22A-7	0.1440	1.4595	126.4408	235.1550	2.0216	16.7963	99.8457	0.9882	
29-22A-8	0.2075	0.7593	46.7926	170.4737	2.8371	15.8183	99.9419	0.9647	
29-23A-1	0.1299	0.1962	423.3013	132.8439	2.0647	17.5945	99.4995	1.1251	
29-23A-2	0.1791	0.1423	130.5456	93.5608	2.6469	16.9971	99.8448	1.0429	
29-23A-3	0.2149	0.5937	41.3483	124.9231	3.2408	16.3232	99.9489	1.0645	
29-23A-4	0.1309	0.5843	508.3801	120.3921	2.0901	17.5013	99.3977	1.1321	
29-23A-5	0.1612	0.6331	74.1545	75.8466	2.5131	17.0674	99.9101	1.0975	
29-23A-6	0.2118	0.1204	39.7395	144.9243	3.2253	16.3607	99.9524	1.0748	
29-24A-1	0.2201	0.2317	16.4118	120.0495	3.4891	15.3901	99.9797	1.1189	
29-24A-2	0.2622	0.0972	12.0462	177.4738	4.2008	14.3915	99.9853	1.1336	
29-24A-3	0.1854	0.1374	23.1587	79.4355	3.0506	15.8729	99.9721	1.1584	
29-24A-4	0.1530	0.3333	29.5592	94.5000	2.6605	16.3794	99.9639	1.2222	
29-24A-5	0.1145	1.1146	83.3399	221.3214	2.2403	16.7867	99.8980	1.3730	
29-24A-6	0.1201	1.7020	442.1377	193.4257	1.9025	17.1796	99.4726	1.1213	
29-24A-7	0.1486	1.0305	124.8139	110.5686	2.4021	16.5480	99.8490	1.1379	
29-24A-8	0.1763	0.7237	46.3256	97.0973	2.7056	16.1920	99.9427	1.0807	
29-24A-9	0.2102	0.3639	23.6670	96.2985	3.0865	15.6793	99.9707	1.0356	
29-24A-10	0.2492	0.2046	16.3215	118.4591	3.6552	14.9445	99.9799	1.0371	
29-25A-1	0.1143	2.2371	31.6316	204.4846	1.7412	17.5799	99.9552	1.0682	
29-25A-2	0.2255	0.2261	20.0517	261.5312	3.1585	15.8034	99.9754	0.9890	
29-25A-3	0.2723	0.0936	12.4385	308.1372	3.8417	14.8442	99.9848	0.9990	
29-25A-4	0.3195	0.0798	7.7698	229.8896	4.5838	13.8812	99.9904	1.0192	
29-25A-5	0.3691	0.0	6.7244	150.4854	5.2275	13.0284	99.9919	1.0093	
29-25A-6	0.4187	0.0	7.5448	117.3342	5.9458	12.0201	99.9909	1.0155	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-25A-7	0.4496	0.0	7.0313	118.8596	6.3864	11.3903	99.9915	1.0179	
29-26A-1	0.2620	0.1946	19.7540	224.8737	3.7265	15.2391	99.9758	1.0067	
29-26A-2	0.1599	0.7977	39.4361	233.5829	2.3869	16.9220	99.9567	1.0495	
29-26A-3	0.3605	0.0707	13.7311	19.6720	5.1765	13.3176	99.9833	1.0231	
29-27A-1	0.2732	0.4069	16.3577	136.1642	3.8768	15.0136	99.9789	1.0049	
29-27A-2	0.2760	0.2771	14.5673	134.1297	3.8445	14.8247	99.9817	0.9867	
29-27A-3	0.2767	0.0921	14.5088	129.9713	3.8659	14.7425	99.9824	0.9896	
29-27A-4	0.3657	0.1394	9.7697	114.2914	5.2843	12.8051	99.9878	1.0298	
29-27A-5	0.3477	0.0733	8.3548	69.5561	4.9813	13.0910	99.9897	1.0197	
29-28A-1	0.1636	0.3116	21.8198	199.7050	2.1268	14.7928	99.9731	0.9141	
29-28A-2	0.2167	0.4709	13.3876	326.2796	2.6500	14.0036	99.9825	0.8630	
29-28A-3	0.2656	0.3842	9.2457	315.2639	3.2833	13.2735	99.9877	0.8750	
29-28A-4	0.3143	0.4060	6.3844	187.7353	4.1155	12.7968	99.9910	0.9299	
29-28A-5	0.3614	0.3530	7.4072	128.6103	4.7429	12.3000	99.9899	0.9349	
29-28A-6	0.3888	0.3281	6.3048	131.2203	5.0449	12.5189	99.9913	1.0360	
29-28A-7	0.1638	0.4671	25.9196	247.8589	2.4560	16.4719	99.9677	1.0545	
29-28A-8	0.1367	0.1864	24.4717	207.0471	2.0690	16.6898	99.9705	1.0621	
29-28A-9	0.1100	0.2316	24.2749	199.5763	1.7055	17.2688	99.9706	1.0858	
29-28A-10	0.2180	0.0	15.3593	173.8044	3.1330	15.5300	99.9818	1.0140	
29-28A-11	0.1967	0.0	19.2982	220.0770	2.7838	15.9880	99.9771	0.9971	
29-28A-12	0.2479	0.0	11.6930	139.2468	3.5485	14.9759	99.9861	1.0120	
29-28A-13	0.2719	0.0	10.6676	127.4351	3.8686	14.5790	99.9873	1.0075	
29-28A-14	0.2918	0.0874	10.7084	127.1225	4.2030	14.0984	99.9869	1.0214	
29-28A-15	0.2838	0.0	7.0702	125.7488	4.2910	13.9540	99.9916	1.0715	
29-28A-16	0.3280	0.0	6.7981	79.0621	4.8674	13.3004	99.9919	1.0547	
29-28A-17	0.3833	0.0	6.9845	95.4157	5.6077	12.3471	99.9916	1.0437	
29-28A-18	0.3556	0.0	6.2701	82.9544	5.2748	12.6801	99.9925	1.0562	
29-28A-19	0.2987	0.0	6.7176	86.3802	4.5017	13.6693	99.9920	1.0691	
29-28A-20	0.2823	0.0903	7.1024	100.6449	4.1836	13.9466	99.9912	1.0501	
29-29A-1	0.1285	1.6403	24.3016	21.6627	1.7180	17.6761	99.9658	0.9381	
29-29A-2	0.1382	0.5710	29.0829	68.0459	2.0457	0.0	99.9637	1.0395	
29-29A-3	0.1498	0.3510	31.3428	124.6140	2.2213	0.0	99.9618	1.0421	
29-29A-4	0.2043	0.2573	29.5986	308.2036	3.0579	16.0148	99.9640	1.0554	
29-29A-5	0.1253	80.3940	1230.0972	28.5293	1.7994	17.4059	98.2787	1.0390	
29-30A-1	0.2370	0.2218	11.2961	271.8979	3.5448	15.4465	99.9858	1.0567	
29-30A-2	0.2793	0.3767	7.9834	208.7607	4.1765	14.7188	99.9892	1.0599	
29-30A-3	0.3229	0.0814	8.9827	106.5304	4.8513	13.7751	99.9890	1.0674	
29-30A-4	0.3696	0.0	7.8485	68.2892	5.4888	12.8468	99.9906	1.0585	
29-30A-5	0.3686	0.0	9.0848	59.0030	5.5122	12.7898	99.9891	1.0659	
29-30A-6	0.3700	0.0	5.4231	56.6443	5.4947	12.6674	99.9935	1.0585	
29-31A-1	0.3728	0.1410	6.5806	59.0405	5.2626	13.3051	99.9916	1.0063	
29-31A-2	0.3552	0.1480	7.5370	58.4401	5.3320	13.2292	99.9904	1.0689	
29-32A-1	0.3723	0.4952	12.6096	175.9879	5.5941	13.0534	99.9832	1.0713	
29-32A-2	0.2845	0.1848	18.8694	114.5861	4.3432	14.6802	99.9769	1.0821	
29-33A-1	0.2058	0.7675	32.8558	300.6699	2.8469	16.1920	99.9584	0.9759	
29-33A-2	0.2547	0.0	12.3430	108.0459	3.4554	15.3841	99.9853	0.9595	
29-33A-3	0.2735	0.0	9.8487	68.3270	3.7309	14.9509	99.9883	0.9660	
29-33A-4	0.2937	0.0	7.6413	53.5080	4.0382	14.5358	99.9909	0.9751	
29-33A-5	0.3195	0.0	6.3192	52.1580	4.3564	14.0560	99.9924	0.9685	
29-33A-6	0.1947	0.0	46.4051	301.8035	2.7662	16.0740	99.9450	1.0018	
29-33A-7	0.2400	0.0	14.0404	114.7969	3.4186	15.2462	99.9833	1.0066	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-33A-8	0.2671	0.0984	9.2423	92.5915	3.8381	14.7746	99.9886	1.0171	
29-33A-9	0.2845	0.0924	9.4702	102.2408	4.1473	14.3588	99.9884	1.0332	
29-33A-10	0.2573	0.0	10.4719	95.2665	3.6936	14.9132	99.9875	1.0157	
29-33A-11	0.2834	0.0	8.7125	112.3848	4.0926	14.3726	99.9896	1.0235	
29-34A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-35A-1	0.1675	1.7323	26.8753	166.3297	2.4297	16.8288	99.9624	1.0206	
29-35A-2	0.1960	0.9406	22.9671	212.9101	2.8338	16.2928	99.9696	1.0190	
29-35A-3	0.2606	0.6062	12.0675	246.3620	3.7416	15.1140	99.9836	1.0161	
29-35A-4	0.3281	0.3207	9.5832	181.6025	4.6915	13.9032	99.9874	1.0164	
29-35A-5	0.3885	0.1353	9.2528	140.3175	5.6206	12.6548	99.9884	1.0324	
29-35A-6	0.4153	0.0	0.0	133.3187	0.0	0.0	-	-	
29-36A-1	0.2344	2.2576	33.4802	256.8303	3.3921	15.6417	99.9526	1.0227	
29-36A-2	0.2741	0.7687	17.9551	139.6596	4.0340	14.8312	99.9760	1.0423	
29-36A-3	0.2963	0.3551	14.3380	110.0775	4.3789	14.3777	99.9817	1.0484	
29-36A-4	0.3178	0.1654	11.2424	88.5045	4.5813	14.0181	99.9860	1.0241	
29-36A-5	0.3396	0.0774	9.8607	74.2537	4.8681	13.6390	99.9879	1.0198	
29-36A-6	0.3519	0.0	10.7879	68.2637	5.3090	13.2214	99.9871	1.0740	
29-36A-7	0.3746	0.0	9.5369	67.8394	5.2685	12.8599	99.9885	1.0028	
29-36A-8	0.2058	0.1277	28.2702	251.3196	3.0505	15.5040	99.9660	1.0453	
29-36A-9	0.1873	0.1403	29.8445	184.3548	2.7341	15.8298	99.9641	1.0283	
29-36A-10	0.1640	0.1602	29.9662	106.9407	2.3819	16.2430	99.9640	1.0212	
29-36A-11	0.1419	0.3705	31.5232	52.1586	2.0983	16.5757	99.9615	1.0385	
29-36A-12	0.1201	1.3149	39.1068	34.5457	1.8075	16.9648	99.9494	1.0554	
29-37A-1	0.2000	0.6578	95.7588	161.4429	2.8520	16.3982	99.8842	1.0069	
29-37A-2	0.2384	0.2205	25.5053	88.4565	3.3663	15.7733	99.9689	0.9979	
29-37A-3	0.2563	0.1025	16.6687	67.8931	3.6297	15.4534	99.9798	1.0020	
29-37A-4	0.2738	0.0	12.3050	55.5990	3.8381	15.1897	99.9853	0.9927	
29-37A-5	0.2920	0.0	11.5466	49.6530	4.1667	14.7368	99.9862	1.0117	
29-37A-6	0.3111	0.0	8.6662	47.8840	4.3706	14.4155	99.9896	0.9975	
29-37A-7	0.1818	0.7239	193.7571	202.6433	2.5980	16.5194	99.7680	1.0106	
29-37A-8	0.1449	0.9077	151.4088	157.7384	2.0879	17.0442	99.8180	1.0148	
29-37A-9	0.2068	0.2542	125.4525	222.0476	2.7984	16.1250	99.8502	0.9568	
29-37A-10	0.2457	0.2140	30.3106	123.3652	3.4106	15.4475	99.9632	0.9817	
29-37A-11	0.2847	0.0	12.6381	90.2870	3.9434	14.9058	99.9849	0.9819	
29-37A-12	0.3049	0.0	11.0529	89.7142	4.2130	14.4276	99.9868	0.9808	
29-37A-13	0.2652	0.0	20.3672	92.1871	3.6882	15.0136	99.9757	0.9845	
29-37A-14	0.3218	0.0817	10.4786	99.3272	4.4595	14.0370	99.9872	0.9846	
29-37A-15	0.1882	0.2794	257.4526	234.9156	2.5365	16.2616	99.6938	0.9552	
29-37A-16	0.1484	0.7089	97.8228	232.6251	1.9956	16.9177	99.8820	0.9463	
29-37A-17	0.0984	1.3365	34.2029	168.0230	1.4541	17.5159	99.9552	1.0343	
29-38A-1	0.2245	1.1742	90.4826	69.2385	0.0	0.0	99.8885	-	
29-38A-2	0.2596	0.6085	64.8206	31.2578	0.0	0.0	99.9207	-	
29-38A-3	0.2596	0.6085	71.9543	28.8605	0.0	0.0	99.9122	-	
29-38A-4	0.2918	0.2704	41.1410	25.9467	0.0	0.0	99.9500	-	
29-38A-5	0.3117	0.2531	22.4193	30.4708	0.0	0.0	99.9723	-	
29-38A-6	0.2230	1.1820	150.0779	68.9923	0.0	0.0	99.8177	-	
29-38A-7	0.2318	0.6813	129.0332	112.4895	3.1359	15.9292	99.8443	0.9582	
29-38A-8	0.2685	0.2938	69.6143	65.1201	3.5843	15.2712	99.9160	0.9467	
29-38A-9	0.3055	0.1721	26.5924	74.4264	4.1108	14.6490	99.9676	0.9554	
29-38A-10	0.2454	0.5362	110.4552	82.4763	3.3097	15.5910	99.8667	0.9559	
29-38A-11	0.2728	0.5790	77.8887	32.2622	3.6591	15.0828	99.9052	0.9516	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EGR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-38A-12	0.2574	0.8186	47.9709	33.2843	3.5311	15.2335	99.8805	0.9725	
29-38A-13	0.2322	0.3397	52.7190	108.1177	3.2675	16.0177	99.9362	0.9947	
29-38A-14	0.2672	0.1967	21.0791	52.2744	3.6784	15.4098	99.9742	0.9747	
29-38A-15	0.2856	0.0920	12.6084	45.4543	3.9665	15.0703	99.9846	0.9845	
29-38A-16	0.3025	0.0	9.6648	43.5661	4.2128	14.6924	99.9884	0.9881	
29-38A-17	0.3219	0.0	8.3820	41.3504	4.5353	14.2004	99.9900	1.0009	
29-38A-18	0.3404	0.0	7.9223	41.8232	4.7805	13.9160	99.9905	0.9991	
29-38A-19	0.2177	0.2415	94.4542	220.2329	3.0454	15.5229	99.8870	0.9891	
29-38A-20	0.2434	0.2160	38.0925	116.9640	3.4400	15.0703	99.9539	0.9998	
29-38A-21	0.2575	0.1021	22.7405	90.0815	3.6545	14.8058	99.9726	1.0043	
29-38A-22	0.2756	0.0954	15.5166	74.6216	3.9203	14.5600	99.9812	1.0078	
29-38A-23	0.2929	0.1795	11.5216	71.7729	4.1193	14.2691	99.9856	0.9972	
29-38A-24	0.2243	0.2344	53.5563	183.2177	3.2727	15.3155	99.9356	1.0308	
29-38A-25	0.2526	0.2081	19.6111	89.4728	3.7372	14.8124	99.9759	1.0465	
29-38A-26	0.2679	0.1962	15.1066	74.7850	3.8689	14.7113	99.9813	1.0225	
29-38A-27	0.2749	0.0963	13.1837	68.0943	4.0726	14.5411	99.9839	1.0568	
29-38A-28	0.2857	0.1840	11.0142	68.7317	4.2042	14.3329	99.9862	1.0429	
29-38A-29	0.3016	0.1743	8.9351	74.9605	4.3449	14.1625	99.9887	1.0222	
29-39A-1	0.2592	2.0416	125.5466	25.5902	3.5261	16.1789	99.8435	0.9653	
29-39A-2	0.2580	1.6385	113.2724	25.7101	3.5261	16.2493	99.8595	0.9694	
29-39A-3	0.2713	0.7769	94.6454	31.2456	3.7268	16.0359	99.8845	0.9749	
29-39A-4	0.2882	0.1824	64.0045	39.8901	3.9574	15.7782	99.9230	0.9749	
29-39A-5	0.3088	0.0851	24.1023	71.6233	4.3281	15.4591	99.9709	0.9954	
29-40A-1	0.2902	0.1811	9.2815	85.3733	4.0067	14.9822	99.9883	0.9787	
29-40A-2	0.3309	0.0794	8.1409	128.6506	4.5422	14.2642	99.9900	0.9758	
29-40A-3	0.3735	0.1408	9.0220	202.3569	5.1660	13.4492	99.9887	0.9862	
29-40A-4	0.4761	0.0552	6.1262	210.3468	6.5586	11.5336	99.9924	0.9888	
29-40A-5	0.4946	0.0531	6.3523	180.3779	6.7554	11.1701	99.9921	0.9816	
29-40A-6	0.5331	0.0	6.7433	123.1074	7.2771	10.5376	99.9918	0.9836	
29-40A-7	0.5749	0.0	6.2533	95.1397	7.7741	9.8072	99.9924	0.9771	
29-40A-8	0.6178	0.0425	6.1841	82.4508	8.4440	8.9202	99.9923	0.9904	
29-40A-9	0.2646	0.0	11.0256	75.7208	3.6891	14.7057	99.9868	0.9870	
29-40A-10	0.2455	0.1071	38.6638	53.6924	3.4150	14.9445	99.9536	0.9841	
29-40A-11	0.2253	0.9355	81.8723	36.5714	3.1670	15.2335	99.8995	0.9941	
29-41A-1	0.5258	0.0	5.5565	53.6464	7.3343	10.6152	99.9933	1.0045	
29-41A-2	0.5427	0.0969	6.2146	54.1630	7.6835	10.3158	99.9921	1.0208	
29-41A-3	0.4749	0.0553	5.6740	74.1048	6.6839	11.5527	99.9930	1.0102	
29-41A-4	0.4248	0.0619	6.3428	106.7047	6.0810	12.1637	99.9921	1.0240	
29-42A-1	0.4248	0.0619	5.8177	91.9928	6.0854	11.9157	99.9928	1.0248	
29-42A-2	0.4610	0.0570	5.8496	75.4850	6.5518	11.2658	99.9927	1.0192	
29-42A-3	0.5114	0.0	5.2725	61.3405	7.1171	10.5184	99.9936	1.0013	
29-43A-1	0.2426	0.2167	71.3443	211.6639	3.4120	15.6359	99.9144	0.9953	
29-43A-2	0.2903	0.1811	17.0647	136.3835	4.0759	14.7302	99.9790	0.9956	
29-43A-3	0.3371	0.1560	6.6580	87.9743	4.7432	13.7751	99.9915	1.0006	
29-43A-4	0.3629	0.0724	6.1655	69.0183	5.0244	13.3699	99.9923	0.9864	
29-43A-5	0.3803	0.0691	5.9053	54.4126	5.3189	13.0094	99.9927	0.9974	
29-43A-6	0.4040	0.0650	5.5589	47.4706	5.5672	12.6674	99.9931	0.9843	
29-43A-7	0.4199	0.0626	4.2777	42.0701	5.8183	12.2766	99.9946	0.9909	
29-43A-8	0.4457	0.1180	5.5444	39.4837	6.1614	11.7052	99.9929	0.9903	
29-43A-9	0.4669	0.0563	6.2580	40.2351	6.4492	11.2853	99.9922	0.9909	
29-43A-10	0.3076	0.0854	10.2250	131.5257	4.2739	13.9453	99.9875	0.9863	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	MCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-43A-11	0.3501	0.0	5.7761	116.8607	4.8960	13.1612	99.9931	0.9953	
29-43A-12	0.3947	0.0	5.1166	89.1555	5.4475	12.4772	99.9938	0.9853	
29-43A-13	0.4437	0.0592	5.0624	86.7344	6.0840	11.6004	99.9937	0.9822	
29-43A-14	0.4134	0.0636	5.9774	85.4400	5.6953	12.0773	99.9926	0.9847	
29-43A-15	0.3771	0.0697	6.5489	93.6745	5.2578	12.5809	99.9919	0.9943	
29-43A-16	0.3358	0.0	6.0186	124.0055	4.7802	13.1802	99.9928	1.0123	
29-43A-17	0.2955	0.1779	12.9426	149.1611	4.1735	13.8245	99.9839	1.0019	
29-43A-18	0.2511	0.1047	79.1086	259.2520	3.4799	14.6368	99.9055	0.9817	
29-44A-1	0.1922	1.5092	109.2451	230.3388	0.0	13.8613	99.8654	-	
29-44A-2	0.2275	0.6942	47.7649	134.4010	0.0	12.8443	99.9409	-	
29-44A-3	0.2622	0.5017	8.5506	73.3840	3.5141	15.3389	99.9881	0.9482	
29-44A-4	0.2794	0.4709	0.0	52.8300	3.7463	14.9387	99.9984	0.9496	
29-44A-5	0.2980	0.4415	9.0457	40.6203	3.9709	14.5506	99.9877	0.9452	
29-44A-6	0.3149	0.1670	8.5611	35.1534	4.1656	14.2684	99.9892	0.9394	
29-44A-7	0.3327	0.0790	6.7496	34.0660	4.4061	13.9294	99.9916	0.9416	
29-44A-8	0.3506	0.0750	5.7595	35.9032	4.6296	13.5974	99.9928	0.9400	
29-44A-9	0.2016	1.0452	139.0967	321.6084	2.6015	18.8065	99.8314	0.9126	
29-44A-10	0.2352	0.7836	43.2520	155.7229	3.0607	18.1745	99.9459	0.9199	
29-44A-11	0.2726	0.6763	12.3622	80.2801	3.5481	17.5253	99.9830	0.9219	
29-44A-12	0.3071	0.5142	8.0380	68.0241	3.9412	16.9567	99.9886	0.9108	
29-44A-13	0.3275	0.5628	7.5320	75.8607	4.2303	16.5551	99.9891	0.9179	
29-44A-14	0.2920	0.7217	9.2251	68.8361	3.7915	17.1929	99.9865	0.9207	
29-45A-1	0.2234	0.4710	20.0089	92.6522	2.9638	16.2211	99.9746	0.9367	
29-45A-2	0.2597	0.1012	13.7681	54.5697	3.4414	15.5852	99.9832	0.9378	
29-45A-3	0.2764	0.0951	12.1130	47.9199	3.6661	15.3088	99.9852	0.9395	
29-45A-4	0.2932	0.1793	9.8917	45.1715	3.8748	15.0011	99.9876	0.9370	
29-45A-5	0.3107	0.0	8.6159	46.2462	4.0971	14.6357	99.9897	0.9362	
29-45A-6	0.1880	0.1398	32.1458	158.7957	2.5082	16.5569	99.9614	0.9399	
29-45A-7	0.1543	0.5111	40.6145	135.7932	2.0288	17.1004	99.9502	0.9241	
29-45A-8	0.1625	0.4853	45.5080	243.2321	2.0765	16.9693	99.9445	0.8989	
29-45A-9	0.1961	0.0	26.2075	223.3790	2.6400	16.2805	99.9689	0.9487	
29-45A-10	0.2303	0.0	15.5039	127.3639	3.0688	15.7733	99.9816	0.9412	
29-45A-11	0.2679	0.0	12.5008	79.7232	3.5336	15.1458	99.9851	0.9340	
29-45A-12	0.2865	0.0	10.1246	79.5971	3.8964	14.7368	99.9879	0.9640	
29-45A-13	0.2580	0.0	12.9684	85.0619	3.4627	15.2085	99.9845	0.9495	
29-45B-1	0.1890	0.8357	107.9813	192.8322	2.5378	16.6266	99.8692	0.9480	
29-45B-2	0.2234	0.5890	64.3452	99.5965	2.9791	16.1283	99.9215	0.9427	
29-45B-3	0.2593	0.4058	39.7543	52.5721	3.4547	15.5172	99.9513	0.9435	
29-45B-4	0.2760	0.4768	37.3777	44.5836	3.6634	15.1643	99.9538	0.9410	
29-45B-5	0.2932	0.7187	38.6559	41.9569	3.9424	14.7918	99.9514	0.9542	
29-45B-6	0.3107	0.7633	33.1708	43.2238	4.1406	14.4625	99.9577	0.9467	
29-45B-7	0.3271	0.6442	31.5070	47.7493	4.3666	14.1823	99.9601	0.9493	
29-45B-8	0.1968	1.3398	65.1138	256.0125	2.6301	16.1333	99.9657	0.9421	
29-45B-9	0.2323	0.9074	12.9267	121.6771	3.1223	15.6100	99.9816	0.9495	
29-45B-10	0.2654	0.6944	8.8740	73.8276	3.6342	14.9843	99.9871	0.9691	
29-45B-11	0.2863	0.5516	7.4809	69.1371	3.8856	14.5931	99.9892	0.9618	
29-45B-12	0.3046	0.5185	6.3267	81.9272	4.1299	14.2944	99.9907	0.9621	
29-46A-1	0.1318	1.1985	276.6311	100.1500	1.7406	11.9623	99.6693	0.9331	
29-46A-2	0.1715	0.7671	615.3738	15.4925	2.2430	16.9082	99.2687	0.9347	
29-46A-3	0.2106	0.1248	60.6034	22.4131	2.7748	16.2800	99.9276	0.9305	
29-46A-4	0.2484	0.0	23.2582	23.4203	3.2697	15.5190	99.9723	0.9308	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CUQ1	OXQ1	EFFGA	CFRAC	NOTE
29-46A-5	0.1339	0.9824	735.2073	166.6794	1.7791	17.3250	99.1307	0.9498	
29-46A-6	0.1803	0.4376	499.2507	30.5011	2.2817	16.7047	99.4070	0.9029	
29-46A-7	0.2188	0.0	32.5684	114.6784	2.8928	15.9907	99.9613	0.9333	
29-46A-8	0.1988	0.1322	119.6826	53.2061	2.5724	16.3091	99.8576	0.9146	
29-46A-9	0.1556	0.6762	853.6665	40.3312	2.0240	16.9154	98.9879	0.9347	
29-46A-10	0.1982	0.0	75.8570	96.0976	2.6798	16.1802	99.9100	0.9543	
29-46A-11	0.1785	0.4419	453.7810	32.5479	2.3076	16.5805	99.4609	0.9206	
29-46A-12	0.1344	0.9788	1011.0476	72.4319	1.7791	17.1313	98.8025	0.9533	
29-46A-13	0.1113	1.4186	608.8843	272.1072	1.5480	17.4059	99.2772	0.9887	
29-47A-1	0.2269	2.2147	62.0491	184.0555	3.0198	16.0378	99.9188	0.9408	
29-47A-2	0.2620	1.1073	24.5012	106.3350	3.4600	15.4970	99.9671	0.9349	
29-47A-3	0.2983	0.5294	12.2645	52.7955	3.9018	14.8726	99.9836	0.9279	
29-47A-4	0.3142	0.3348	10.1911	41.6799	4.1602	14.5381	99.9867	0.9402	
29-47A-5	0.3332	0.0789	8.2281	37.5133	4.3721	14.2588	99.9899	0.9329	
29-47A-6	0.3505	0.0750	7.8182	36.9969	4.6256	13.9300	99.9904	0.9395	
29-47A-7	0.2345	0.2242	42.1391	195.4846	3.2024	15.5636	99.9491	0.9654	
29-47A-8	0.2723	0.0	15.9796	120.9818	3.5520	15.0952	99.9809	0.9240	
29-47A-9	0.3128	0.0	8.7582	68.5608	4.1543	14.3958	99.9895	0.9429	
29-47A-10	0.3279	0.0	8.3615	67.6277	4.3444	14.0909	99.9900	0.9417	
29-47A-11	0.2902	0.0	10.2434	84.8315	3.8238	14.7054	99.9878	0.9341	
29-47A-12	0.1013	3.6506	18.0385	29.5717	1.4069	17.5011	99.9665	0.9729	
29-47A-13	0.1060	1.9890	17.2379	161.7860	1.4750	17.5011	99.9730	0.9749	
29-48A-1	0.2086	0.5045	147.7806	36.6034	2.6817	16.6179	99.8229	0.9100	
29-48A-2	0.2282	0.1152	47.6107	62.3553	2.9820	16.1777	99.9430	0.9235	
29-48A-3	0.1905	0.2760	288.2112	47.2599	2.4523	16.7336	99.6573	0.9136	
29-48A-4	0.1718	0.3060	462.3049	79.7690	2.2205	16.9511	99.4515	0.9202	
29-48A-5	0.2018	0.0	180.5481	39.6875	2.6239	16.4833	99.7858	0.9208	
29-48A-6	0.0868	1.2128	21.1498	210.5674	1.1953	18.2198	99.9710	0.9637	
29-48A-7	0.1635	0.3216	557.9277	67.9222	2.1147	16.9696	99.3386	0.9229	
29-48A-8	0.2005	0.0	174.2713	22.9557	2.6568	16.3397	99.7932	0.9379	
29-48A-9	0.2376	0.0	32.0580	28.6684	3.1091	15.7822	99.9619	0.9248	
29-48A-10	0.1822	0.1443	389.2205	27.8250	2.3953	16.5438	99.5383	0.9348	
29-49A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-50A-1	0.2218	0.3556	0.0	21.9659	3.0126	16.2170	99.9988	0.9581	
29-50A-2	0.2769	0.0949	0.0	109.1993	3.8667	15.2006	99.9997	0.9891	
29-50A-3	0.2340	0.1123	0.0	34.0606	3.2409	15.8931	99.9996	0.9778	
29-50A-4	0.2127	2.1128	687.8772	36.2391	2.8624	16.3275	99.1760	0.9661	
29-50A-5	0.2624	0.8032	57.7736	25.1131	3.5918	15.5322	99.9284	0.9700	
29-50A-6	0.3088	0.5969	16.4470	30.1593	4.2176	14.7244	99.9783	0.9696	
29-50A-7	0.3609	0.2186	19.0302	29.8558	4.9523	13.7806	99.9764	0.9777	
29-50A-8	0.2396	0.1097	135.7393	25.8372	3.3264	15.8245	99.8381	0.9841	
29-50A-9	0.1900	0.1383	770.0432	60.7697	2.5625	16.6127	99.0865	0.9687	
29-50A-10	0.1631	0.1611	503.4910	198.9030	2.2785	16.9620	99.4036	0.9939	
29-50A-11	0.1387	0.3790	107.9081	315.7349	1.9387	17.3838	99.8712	0.9831	
29-50A-12	0.0999	1.0530	0.0	97.8669	1.3527	18.1146	99.9965	0.9473	
29-50A-13	0.2222	0.0	534.3796	44.8045	3.0045	15.9671	99.3650	0.9674	
29-50A-14	0.1889	0.0	818.5503	106.6270	2.5131	16.6311	99.0295	0.9570	
29-50A-15	0.2435	0.0	144.5229	39.2794	3.3657	15.5599	99.8280	0.9804	
29-50A-16	0.2329	0.0	401.7187	36.4936	3.1194	15.9116	99.5223	0.9557	
29-50A-17	0.2694	0.0	18.1839	83.0269	3.7380	15.1761	99.9783	0.9827	
29-50A-18	0.3196	0.0	12.5547	128.8573	4.3745	14.5250	99.9850	0.9725	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-50A-19	0.2337	0.0	319.9768	35.2331	3.1583	16.0040	99.6195	0.9620	
29-51A-1	0.2745	0.3833	19.8006	256.4167	3.7621	15.5026	99.9751	0.9709	
29-51A-2	0.2231	0.1178	24.3629	82.4837	3.0556	16.3140	99.9706	0.9670	
29-51A-3	0.1637	0.4820	101.8750	54.0890	2.6170	16.8928	99.8778	1.1263	
29-51A-4	0.1483	0.5320	164.6446	52.5309	2.3302	17.2372	99.8035	1.1073	
29-51A-5	0.1091	0.9647	420.2061	114.0061	1.9104	17.8227	99.5013	1.2367	3
29-51A-6	0.2283	0.1151	25.4043	102.0611	3.1943	16.0461	99.9694	0.9881	
29-51A-7	0.1876	0.2802	145.1798	39.7002	2.5823	16.7599	99.8270	0.9723	
29-51A-8	0.1621	0.3243	276.1370	61.9149	2.3122	17.0722	99.6721	1.0091	
29-51A-9	0.1397	0.5646	407.7400	139.6822	1.9804	17.4571	99.5163	1.0046	
29-51A-10	0.1160	0.9067	227.8474	389.8816	1.6659	17.7679	99.7282	1.0112	
29-51A-11	0.2072	0.0	63.2715	50.6833	2.7869	16.4285	99.9249	0.9495	
29-51A-12	0.1878	0.0	120.7944	38.2453	2.5972	16.7047	99.8568	0.9767	
29-51A-13	0.1830	0.1436	156.5308	38.8660	2.4884	16.8334	99.8140	0.9606	
29-51A-14	0.1375	0.3825	446.0969	76.8795	1.9520	17.4716	99.4717	1.0072	
29-51A-15	0.1585	0.3318	321.2356	36.9156	2.1814	17.2149	99.6188	0.9750	
29-51A-16	0.1785	0.1472	179.8900	27.5642	2.4442	16.9762	99.7864	0.9677	
29-51A-17	0.1827	0.1438	143.6041	27.2921	2.5377	16.9027	99.8293	0.9808	
29-51A-18	0.1991	0.0	63.0385	31.0642	2.7368	16.7231	99.9252	0.9698	
29-51A-19	0.2190	0.0	26.4829	35.8357	3.0198	16.4101	99.9685	0.9732	
29-51A-20	0.2382	0.0	21.3502	34.6230	3.2822	16.0779	99.9746	0.9736	
29-52A-1	0.3159	0.1664	9.9346	83.1962	4.2592	14.9784	99.9875	0.9576	
29-52A-2	0.2678	0.1963	18.9946	95.6655	3.6440	15.6863	99.9767	0.9636	
29-52A-3	0.2237	0.3526	25.1287	226.9232	3.0556	16.3910	99.9689	0.9644	
29-52A-4	0.2781	0.0	15.7305	83.4053	3.8897	15.2073	99.9812	0.9908	
29-52A-5	0.3059	0.0	8.5355	79.0961	4.3749	14.7422	99.9898	1.0151	
29-52A-6	0.3315	0.0	6.8134	91.5804	4.6332	14.3438	99.9918	0.9936	
29-52A-7	0.3513	0.0	6.4288	117.0694	4.9836	13.9248	99.9923	1.0098	
29-52A-8	0.2458	0.0	19.9694	124.8495	3.4333	15.7529	99.9762	0.9876	
29-52A-9	0.2286	0.0	20.6900	161.6857	3.2511	15.9753	99.9754	1.0042	
29-52A-10	0.2002	0.1313	22.7457	329.4429	2.8574	16.4143	99.9726	1.0063	
29-52A-11	0.3053	0.0	9.7012	64.8766	4.5136	14.4426	99.9884	1.0491	
29-52A-12	0.2914	0.0	9.5608	58.6153	4.1607	14.9286	99.9886	1.0122	
29-52A-13	0.2626	0.0	15.3090	64.0242	3.7611	15.3199	99.9818	1.0135	
29-52A-14	0.2389	0.0	18.3121	92.0790	3.4124	15.7714	99.9782	1.0093	
29-52A-15	0.2153	0.1221	21.9720	187.8992	3.0403	16.1788	99.9735	0.9964	
29-52A-16	0.1920	0.1369	20.0246	304.9858	2.7117	16.5528	99.9758	0.9952	
29-52A-17	0.3397	0.0	5.6238	70.0490	4.8054	14.1380	99.9933	1.0062	
29-53A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-54A-1	0.2653	0.0991	114.4970	124.0287	3.6334	15.6064	99.8632	0.9719	
29-54A-2	0.2435	0.0	156.0720	95.2155	3.3238	15.9173	99.8143	0.9682	
29-54A-3	0.2175	0.0	491.9077	45.4543	2.9638	16.2723	99.4157	0.9733	
29-54A-4	0.2148	0.0	619.0208	37.1665	2.8979	16.3643	99.2648	0.9667	
29-54A-5	0.2122	0.0	646.0229	35.8099	2.8272	16.4012	99.2329	0.9555	
29-54A-6	0.1980	0.0	790.6221	29.8318	2.7067	16.4931	99.0621	0.9826	
29-54A-7	0.1802	0.1458	994.4375	28.4789	2.5180	16.6585	98.8212	1.0075	
29-54A-8	0.1678	0.1566	1099.9487	34.7371	2.3463	16.8097	98.6973	1.0099	
29-55A-1	0.2506	0.0	98.7658	60.1977	3.5169	15.6340	99.8824	0.9944	
29-55A-2	0.2085	0.0	353.1062	42.8487	3.1221	16.0779	99.5808	1.0641	
29-55A-3	0.1984	0.1325	489.7676	45.6765	2.9944	16.2072	99.4185	1.0756	
29-55A-4	0.1792	0.0	669.8457	57.2290	2.8023	16.3869	99.2064	1.1168	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-55A-5	0.1499	0.3508	728.1130	144.6546	2.3521	16.8659	99.1379	1.1199	
29-55A-6	0.2418	0.0	99.2097	79.8795	3.5327	15.5172	99.8819	1.0345	
29-55A-7	0.2946	0.0	52.7841	137.7773	4.2313	14.6549	99.9370	1.0197	
29-55A-8	0.2206	0.0	236.0088	60.1105	3.2872	15.7529	99.7196	1.0573	
29-55A-9	0.1898	0.1384	719.7156	46.9892	2.7772	16.2343	99.1462	1.0477	
29-55A-10	0.2791	1.9916	263.0210	111.5675	3.7127	15.4559	99.6795	0.9488	
29-55A-11	0.2408	1.0948	746.1063	64.1992	3.2768	15.9753	99.1086	0.9799	
29-55A-12	0.2062	0.8940	1136.7097	50.1044	2.8677	16.4744	98.6478	1.0085	
29-55A-13	0.1971	0.6675	1136.0569	51.7281	2.7972	16.5298	98.6501	1.0277	
29-55A-14	0.1801	0.7303	1142.5227	64.3477	2.5977	16.7510	98.6458	1.0428	
29-55A-15	0.1492	0.8820	1107.8345	119.6216	2.3326	17.1191	98.6872	1.1252	
29-55A-16	0.3156	0.3334	131.9592	144.4888	4.1820	14.8415	99.8411	0.9443	
29-55A-17	0.3402	0.3093	108.8021	147.9489	4.3800	14.5614	99.8686	0.9183	
29-55A-18	0.2362	0.1113	485.9321	119.6945	3.4644	15.6601	99.4217	1.0478	
29-55A-19	0.1810	0.2905	1147.1826	60.0400	2.7271	16.6174	98.6397	1.0887	
29-55A-20	0.3923	0.0670	62.7156	145.2370	5.3445	13.3720	99.9244	0.9740	
29-56A-1	0.4017	0.3932	82.7882	163.5083	5.3096	13.1913	99.8991	0.9461	
29-56A-2	0.3477	0.9106	130.3736	159.7340	4.6474	14.0748	99.8407	0.9544	
29-56A-3	0.2852	0.4612	271.7505	149.2715	4.0567	14.7482	99.6741	1.0145	
29-56A-4	0.2248	0.1169	845.9036	56.9994	3.2406	15.7343	98.9943	1.0384	
29-56A-5	0.2090	0.1257	1071.3271	49.4763	2.9031	16.0123	98.7277	1.0057	
29-56A-6	0.1953	0.1345	1176.8521	63.1691	2.7171	16.2528	98.6037	1.0088	
29-56A-7	0.2158	0.0	998.7051	46.6763	3.0046	15.8270	98.8138	1.0067	
29-56A-8	0.2223	0.0	921.2693	52.2163	3.0914	15.6787	98.9053	1.0042	
29-56A-9	0.2780	4.2251	115.4039	155.2715	3.6914	14.9348	99.8481	0.9433	
29-56A-10	0.2288	2.8963	271.1692	109.4000	3.0914	15.6601	99.6679	0.9604	
29-56A-11	0.1960	1.6157	823.8340	54.4239	2.6473	16.2108	99.0174	0.9720	
29-56A-12	0.1768	1.4910	1048.3748	44.1270	2.4009	16.4280	98.7531	0.9811	
29-56A-13	0.1646	1.2805	1207.7776	46.1866	2.2454	16.6359	98.5661	0.9687	
29-56A-14	0.1614	1.1422	1295.2727	45.4413	2.1923	16.6313	98.4634	0.9866	
29-56A-15	0.1533	1.0305	1313.0117	48.2648	2.0534	16.8388	98.4436	0.9734	
29-57A-1	0.3155	2.9037	11.0402	49.7217	4.3222	14.4605	99.9769	0.9730	
29-57A-2	0.3663	1.9813	6.6284	31.3125	4.9379	13.6218	99.9853	0.9605	
29-57A-3	0.3894	1.5857	6.2407	30.4918	5.3185	13.1373	99.9871	0.9749	
29-57A-4	0.3703	1.2300	6.0905	29.8942	4.9942	13.4514	99.9885	0.9614	
29-57A-5	0.3463	1.1596	6.5075	32.7374	4.6971	13.8111	99.9883	0.9653	
29-57A-6	0.3231	0.9933	9.1477	74.2061	4.4153	14.0947	99.9857	0.9710	
29-57A-7	0.3449	0.8527	6.5479	54.0172	4.7674	13.6408	99.9892	0.9836	
29-57A-8	0.3741	0.7144	6.4955	51.9457	5.1871	13.0914	99.9898	0.9886	
29-57A-9	0.3512	0.7611	5.9202	48.4827	4.8648	13.4402	99.9903	0.9861	
29-57A-10	0.3593	0.7438	5.7942	46.2665	4.8904	13.3567	99.9905	0.9706	
29-57A-11	0.2812	0.7598	32.8167	116.1088	3.8050	14.5413	99.9583	0.9593	
29-57A-12	0.2277	1.0562	140.1701	403.9541	3.1167	15.3210	99.8298	0.9698	
29-57A-13	0.1671	1.4390	55.1870	298.1648	2.3669	16.2236	99.9298	0.9971	
29-58A-1	0.3876	1.1550	5.7231	64.5054	5.5047	13.3347	99.9892	1.0133	
29-58A-2	0.3293	0.7173	7.2587	120.4852	4.7402	14.2458	99.9889	1.0231	
29-58A-3	0.4065	0.4516	5.0344	51.9100	5.8503	12.7805	99.9924	1.0282	
29-58A-4	0.4306	0.6553	4.7533	55.4625	6.1536	12.4588	99.9913	1.0228	
29-58A-5	0.4143	0.5066	4.9398	51.7360	5.9688	12.6481	99.9923	1.0298	
29-58A-6	0.4054	0.3232	5.0483	49.6114	5.8090	12.7616	99.9928	1.0237	
29-58A-7	0.3105	0.2530	7.6989	117.1449	4.5741	14.2122	99.9899	1.0001	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-58A-8	0.3614	0.2174	4.7141	50.7203	5.0278	13.4788	99.9936	0.9910	
29-58A-9	0.3873	0.1351	4.3980	36.4037	5.3887	13.0072	99.9942	0.9927	
29-58A-10	0.4096	0.1278	4.1591	30.7179	5.6622	12.7237	99.9946	0.9879	
29-58A-11	0.4344	0.1808	4.3159	30.6333	6.0639	12.1075	99.9942	0.9991	
29-58A-12	0.4274	0.1225	4.3867	30.3631	5.8976	12.2591	99.9943	0.9872	
29-58A-13	0.4123	0.1270	4.1322	29.8781	5.7149	12.4484	99.9946	0.9908	
29-59A-1	0.3025	0.2608	8.5649	150.1669	4.2318	14.8059	99.9889	0.9926	
29-59A-2	0.2769	0.2849	15.5164	124.9168	3.8061	15.3222	99.9758	0.9739	
29-59A-3	0.2474	0.3189	81.8132	73.7705	3.3435	15.8806	99.9015	0.9573	
29-59A-4	0.2154	0.2441	331.8130	43.5337	2.9184	16.3447	99.6051	0.9640	
29-59A-5	0.1929	0.4114	439.6760	53.2718	2.6478	16.6596	99.6279	0.9783	
29-59A-6	0.1833	0.4304	494.1938	64.8026	2.4798	16.7752	99.4129	0.9643	
29-59A-7	0.2020	0.3904	421.9219	46.3511	2.7175	16.4607	99.4980	0.9582	
29-59A-8	0.2889	0.0910	14.4222	36.1832	3.8594	14.899.	99.9825	0.9471	
29-59A-9	0.2702	0.0973	36.6472	33.2838	3.6048	15.2603	99.9560	0.9453	
29-59A-10	0.2428	0.1082	161.8862	29.9134	3.2349	15.6519	99.8070	0.9454	
29-59A-11	0.2114	0.3732	424.9395	29.3558	2.8378	16.1169	99.4942	0.9572	
29-59A-12	0.2003	0.5253	513.4431	30.6477	2.6329	16.3397	99.3890	0.9389	
29-59A-13	0.1527	0.8615	584.7451	91.2071	2.0678	16.9424	99.3056	0.9653	
29-60A-1	0.2827	0.4654	9.7436	146.6257	4.0204	14.9801	99.9868	1.0078	
29-60A-2	0.2446	0.7536	71.4723	94.0986	3.3694	15.7986	99.9124	0.9751	
29-60A-3	0.2169	0.6066	274.1453	73.6253	3.0199	16.1324	99.6723	0.9888	
29-60A-4	0.1863	0.7062	485.8372	101.2582	2.6926	16.5025	99.4217	1.0293	
29-60A-5	0.2075	0.3803	393.8191	81.7013	2.8127	16.3175	99.5312	0.9654	
29-60A-6	0.2710	0.1940	15.9625	39.0365	3.7051	15.2037	99.9803	0.9681	
29-60A-7	0.2388	0.2202	127.5490	33.7324	3.2865	15.7057	99.8475	0.9755	
29-60A-8	0.2154	0.1220	362.0527	38.2507	2.9843	15.9470	99.5696	0.9860	
29-60A-9	0.1835	0.2865	615.5342	48.5091	2.4847	16.5025	99.2695	0.9681	
29-60A-10	0.1533	0.3430	425.8401	114.6769	2.1109	16.9642	99.4952	0.9777	
29-60A-11	0.1218	0.6475	162.3316	182.3696	1.7045	17.4432	99.8062	0.9844	
29-60A-12	0.2861	0.0	11.4516	37.9097	3.8327	14.8559	99.9863	0.9495	
29-61A-1	0.3045	0.3456	9.6179	109.6878	4.3168	14.7253	99.9873	1.0062	
29-61A-2	0.2688	0.0	42.1329	40.5611	3.8450	15.2654	99.9498	1.0136	
29-61A-3	0.2346	0.0	337.7456	31.2656	3.3752	15.6741	99.5983	1.0245	
29-61A-4	0.2159	0.1217	635.1069	44.8023	3.0607	16.0078	99.2452	1.0156	
29-61A-5	0.1918	0.1370	169.3766	175.8536	2.8174	16.3225	99.7987	1.0383	
29-61A-6	0.2486	0.0	83.4267	47.6892	3.5427	15.4142	99.9007	1.0093	
29-61A-7	0.2310	0.1138	123.0890	56.4169	3.3700	15.6129	99.8533	1.0331	
29-61A-8	0.2757	0.0	29.2268	39.8221	3.9578	14.9055	99.9651	1.0174	
29-61A-9	0.2548	0.0	60.4663	23.4137	3.7330	15.1850	99.9280	1.0375	
29-61A-10	0.2199	0.0	192.5954	28.1426	3.1786	15.7429	99.7712	1.0244	
29-61A-11	0.1889	0.0	188.4279	122.9745	2.6772	16.2485	99.7766	1.0024	
29-61A-12	0.2370	0.0	131.9485	23.1894	3.3856	15.4827	99.8430	1.0124	
29-61A-13	0.2946	0.0	12.3090	33.7328	4.2236	14.4761	99.9853	1.0169	
29-61A-14	0.3004	2.5632	41.6622	122.4272	4.1582	14.7253	99.9415	0.9829	
29-61A-15	0.2337	1.6949	284.6997	39.1801	3.2198	15.8782	99.6557	0.9798	
29-61A-16	0.2078	1.6515	592.2527	59.0296	2.8526	16.2990	99.2914	0.9826	
29-61A-17	0.2446	1.0779	164.0988	36.5839	3.3440	15.7057	99.8011	0.9703	
29-61A-18	0.2540	0.8297	95.0398	40.7354	3.4902	15.4699	99.8840	0.9740	
29-61A-19	0.2699	0.6830	54.7298	67.6809	3.7277	5.6004	99.9324	0.9791	
29-61A-20	0.2397	0.6589	195.2231	35.6534	3.2870	15.5442	99.7655	0.9735	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-61A-21	0.2311	0.5692	223.3846	35.8172	3.2301	15.5628	99.7325	0.9921	
29-61A-22	0.2761	0.3811	99.6248	35.3546	3.8397	14.7749	99.9395	0.9862	
29-61A-23	0.2452	0.3217	94.0954	31.0856	3.3648	15.2781	99.8869	0.9720	
29-61A-24	0.2115	0.4974	195.7304	40.7151	2.9335	15.8040	99.7659	0.9827	
29-61A-25	0.1769	0.7436	197.9735	135.3718	2.4399	16.3595	99.7630	0.9748	
29-61A-26	0.2284	0.3454	141.5009	34.2103	3.1272	15.5442	99.8306	0.9701	
29-61A-27	0.2356	0.3349	117.7508	31.4852	3.2352	15.3956	99.8588	0.9729	
29-62A-1	0.2958	0.3557	6.3832	55.7168	4.2182	14.5255	99.9912	1.0113	
29-62A-2	0.2608	0.2016	7.2416	27.0661	3.6693	15.2163	99.9907	0.9956	
29-62A-3	0.2209	0.2380	20.3784	14.0042	3.1375	15.7374	99.9750	1.0024	
29-63A-1	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-64A-1	0.3665	0.7916	8.5250	168.1567	5.2395	13.3599	99.9871	1.0189	
29-64A-2	0.3638	0.3616	5.7052	170.5425	5.2337	13.4271	99.9919	1.0249	
29-64A-3	0.3151	0.2504	6.0356	106.1139	4.6548	14.1065	99.9919	1.0491	
29-64A-4	0.2853	0.1843	5.4472	59.6311	4.1418	14.8502	99.9929	1.0288	
29-64A-5	0.2413	0.1089	6.4414	26.9157	3.6059	15.5354	99.9920	1.0560	
29-64A-6	0.1967	0.3969	117.7470	10.9707	2.9284	16.2735	99.8590	1.0409	
29-65A-1	0.2844	3.2746	19.0842	82.0268	3.6954	15.3573	99.9661	0.9212	
29-65A-2	0.2809	0.6563	10.5155	95.9319	3.8392	15.0791	99.9852	0.9686	
29-65A-3	0.2511	0.5239	34.5070	63.9045	3.4427	15.6111	99.9571	0.9701	
29-65A-4	0.2233	0.4712	124.5088	68.5536	3.1015	15.9259	99.8504	0.9833	
29-65A-5	0.1842	0.4282	370.9441	131.5272	2.5982	16.4479	99.5589	1.0018	
29-65A-6	0.1978	0.2658	310.0203	92.1007	2.7725	16.2820	99.6313	0.9952	
29-65A-7	0.2227	0.1180	172.0022	65.0610	3.0097	15.9496	99.7952	0.9577	
29-65A-8	0.2301	0.1142	107.8217	58.8940	3.1476	15.7832	99.8714	0.9685	
29-65A-9	0.2753	0.0	10.7296	35.0143	3.7538	15.0048	99.9872	0.9659	
29-65A-10	0.2428	0.0	37.9313	29.6577	3.4114	15.4500	99.9549	0.9935	
29-65A-11	0.2162	0.0	223.0052	27.5625	2.9944	15.9496	99.7351	0.9822	
29-65A-12	0.1828	0.0	501.8257	74.4356	2.4750	16.5584	99.4053	0.9651	
29-65A-13	0.2026	0.0	405.5276	36.1785	2.7775	16.1158	99.5188	0.9760	
29-65A-14	0.2156	0.0	183.6146	25.1247	3.0351	15.8017	99.7819	0.9976	
29-65A-15	0.2183	0.0	159.1854	48.8162	3.0402	15.7462	99.8109	0.9863	
29-65A-16	0.2113	0.0	235.5045	46.8561	2.9437	15.8704	99.7204	0.9880	
29-65A-17	0.2039	0.0	382.3271	43.7248	2.8327	15.9629	99.5462	0.9882	
29-65A-18	0.2263	0.0	86.2725	81.4514	3.1373	15.6667	99.8974	0.9804	
29-65A-19	0.2589	0.0	22.3401	134.3668	3.4636	15.2587	99.9734	0.9467	
29-65A-20	0.1833	0.0	619.9956	56.0163	2.6230	16.2770	99.2652	1.0225	
29-65A-21	0.1984	0.0	470.1824	44.1780	2.7375	16.0923	99.4422	0.9837	
29-65A-22	0.1956	0.0	93.9266	84.4513	2.8227	16.0553	99.8886	1.0187	
29-65A-24	0.2239	0.0	49.3277	69.3368	3.0964	15.7408	99.9414	0.9772	
29-65A-25	0.2469	0.0	16.9563	123.7496	3.5318	15.2030	99.9798	1.0115	
29-65A-26	0.1868	0.0	102.4883	86.5352	2.7575	16.2031	99.8785	1.0418	
29-65A-26	0.2611	0.0	22.1519	125.4412	3.5423	15.2030	99.9736	0.9602	
29-65A-27	0.2331	0.0	73.0920	121.3627	3.1527	15.6111	99.9131	0.9570	
29-65A-28	0.1972	0.0	499.2383	55.4954	2.7375	16.1292	99.4078	0.9901	
29-65A-29	0.1841	0.0	800.1614	45.1335	2.5686	16.2955	99.0517	1.0014	
29-65A-30	0.1689	0.0	959.5234	62.0951	2.2945	16.6275	98.6640	0.9789	
29-65A-31	0.1996	0.0	250.4334	82.3252	2.5883	16.2770	99.7029	0.9197	
29-65A-32	0.2254	0.0	130.4926	68.4619	2.9437	15.9259	99.8449	0.9248	
29-65A-33	0.2440	0.0	60.5196	95.4915	3.1938	15.6111	99.9280	0.9266	
29-65A-34	0.1757	0.0	304.7913	115.6522	2.4162	16.5353	99.6390	0.9747	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-65A-35	0.2902	0.4533	15.6873	115.8874	3.9319	15.1609	99.9797	0.9607	
29-65A-36	0.2649	0.3973	21.9017	100.3045	3.6253	15.5717	99.9725	0.9691	
29-65A-37	0.2291	0.4592	51.5454	81.1910	3.2012	16.0559	99.9372	0.9876	
29-65A-38	0.1967	0.6689	112.3153	111.9409	2.7906	16.5390	99.8645	1.0021	
29-65A-39	0.2173	0.3630	63.7763	80.9030	3.0953	16.1117	99.9230	1.0062	
29-65A-40	0.2249	0.3508	75.0604	77.5481	3.0450	16.1489	99.9096	0.9573	
29-65A-41	0.2411	0.3272	47.4494	91.0378	3.2468	15.8512	99.9424	0.9526	
29-65A-42	0.2031	0.3884	127.2414	83.5116	2.8452	16.3348	99.8477	0.9903	
29-65A-43	0.1892	0.4169	154.6267	97.1425	2.7263	16.4648	99.8153	1.0182	
29-66A-1	0.3332	0.3158	19.5070	49.4689	4.3053	14.1906	99.9756	0.9190	
29-66A-2	0.3605	0.2188	9.6547	43.5147	4.6993	13.7302	99.9877	0.9286	
29-66A-3	0.3807	0.0690	7.2982	42.7805	5.0388	13.0741	99.9910	0.9442	
29-66A-4	0.4105	0.0640	6.3406	44.8475	5.3726	12.7358	99.9921	0.9353	
29-66A-5	0.3143	0.0836	20.1109	58.9857	4.1359	14.1346	99.9757	0.9348	
29-66A-6	0.2854	0.0921	38.0429	82.8392	3.7911	14.4774	99.9543	0.9421	
29-66A-7	0.2616	0.2009	69.4855	138.9182	3.4479	14.9057	99.9165	0.9340	
29-66A-8	0.2386	0.2204	116.5339	205.4186	3.0964	15.2402	99.8606	0.9197	
29-66A-9	0.3129	0.0840	23.6478	88.0776	4.0437	14.1042	99.9714	0.9181	
29-66A-10	0.3418	0.0769	11.2146	70.7657	4.4930	13.5617	99.9863	0.9354	
29-66A-11	0.3688	0.0713	7.0584	68.6425	4.8796	13.0741	99.9913	0.9430	
29-66A-12	0.3959	0.0664	7.0167	79.8461	5.1935	12.5475	99.9913	0.9366	
29-66A-13	0.2921	0.0900	32.1612	108.3825	3.8392	14.2162	99.9613	0.9327	
29-66A-14	0.2637	0.0997	84.3523	173.0540	3.4584	14.6637	99.8991	0.9299	
29-67A-1	0.2168	0.3638	34.9510	117.1609	3.1931	15.8959	99.9572	1.0394	
29-67A-2	0.1946	0.4053	49.2007	111.4461	2.9239	16.3372	99.9403	1.0592	
29-67A-3	0.1719	0.1529	72.8546	100.0165	2.6299	16.6273	99.9132	1.0777	
29-67A-4	0.1519	0.1730	137.4499	90.7177	2.3032	16.9925	99.8369	1.0680	
29-67A-5	0.1277	0.2058	211.4117	106.1967	1.9793	17.3840	99.7497	1.0918	
29-67A-6	0.1027	0.2559	264.7859	203.6415	1.5993	17.8108	99.6871	1.0962	
29-67A-7	0.1814	0.0	140.0177	101.8094	2.6003	16.5566	99.8341	1.0120	
29-67A-8	0.1637	0.0	169.8081	101.8977	2.3660	16.8306	99.7990	1.0198	
29-67A-9	0.1454	0.0	234.7894	98.3027	2.1165	17.1344	99.7225	1.0278	
29-67A-10	0.1256	0.0	347.4614	97.3498	1.8762	17.3815	99.5898	1.0556	
29-67A-11	0.1044	0.2518	387.4189	163.2786	1.6038	17.7116	99.5425	1.0853	
29-67A-12	0.2066	0.0	118.1327	122.9313	2.6892	16.2962	99.8598	0.9202	
29-67A-13	0.1801	0.0	149.9384	116.1614	2.4096	16.7384	99.8223	0.9452	
29-67A-14	0.1517	0.0	200.5298	109.4635	2.0927	17.0891	99.7628	0.9733	
29-67A-15	0.1268	0.2073	259.4438	105.7994	1.8018	17.4248	99.6930	1.0028	
29-67A-16	0.1017	0.5169	236.0916	243.0943	1.4766	17.8475	99.7200	1.0217	
29-67A-17	0.2115	0.6201	57.8475	45.5111	2.6731	16.6056	99.9292	0.8924	
29-67A-18	0.1907	0.5501	87.6358	44.6074	2.3578	17.1488	99.8942	0.8727	
29-67A-19	0.1676	0.6259	139.8535	60.9738	2.0391	17.4787	99.8323	0.8587	
29-67A-20	0.1770	0.5926	122.5146	49.7356	2.1542	17.3234	99.8529	0.8591	
29-67A-21	0.2317	0.3395	34.7639	40.9015	2.8934	16.1597	99.9575	0.8826	
29-67A-22	0.2283	0.2296	40.0207	117.2426	3.0199	16.0762	99.9516	0.9349	
29-67A-23	0.2047	0.2560	64.2747	96.0054	2.6433	16.4893	99.9229	0.9115	
29-67A-24	0.1731	0.7577	116.3466	75.9989	2.3189	16.8330	99.8597	0.9449	
29-67A-25	0.1452	1.2657	190.0077	112.9547	1.9438	17.2602	99.7711	0.9443	
29-67A-26	0.1619	0.9727	145.9985	76.7524	2.1976	16.8965	99.8240	0.9576	
29-67A-27	0.2227	0.1177	51.6454	111.4353	3.3375	15.2879	99.9382	1.0587	
29-67A-28	0.1986	0.1320	76.5785	103.9055	3.0300	15.9078	99.9087	1.0768	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-67A-29	0.1737	0.1509	121.5072	99.7758	2.6483	16.1403	99.8556	1.0752	
29-67A-30	0.1492	0.1756	188.9150	82.2948	2.2412	16.7996	99.7760	1.0591	
29-67A-31	0.1263	0.4151	250.4886	94.9429	1.9914	17.1100	99.7029	1.1118	
29-68A-1	0.1704	0.6409	59.7080	45.7154	2.0230	17.3618	99.9267	0.8530	
29-68A-2	0.2221	0.6149	80.3738	222.2449	2.7429	16.3526	99.9019	0.8908	
29-68A-3	0.2810	0.6813	20.7274	89.2460	3.4404	15.4760	99.9728	0.8854	
29-68A-4	0.3148	0.5209	10.4318	55.4846	3.8490	14.9612	99.9857	0.8857	
29-68A-5	0.3578	0.5350	7.5507	43.2886	4.3361	14.1979	99.9891	0.8804	
29-68A-6	0.3950	0.1381	7.8226	43.5536	4.7792	13.6442	99.9901	0.8812	
29-68A-7	0.2977	0.3668	12.9919	131.8552	3.8596	14.9230	99.9832	0.9197	
29-68A-8	0.3390	0.3221	9.1133	100.4275	4.5210	14.1025	99.9680	0.9485	
29-68A-9	0.3791	0.3603	6.6632	106.9059	4.8677	13.5869	99.9884	0.9158	
29-68A-10	0.3184	0.2572	10.9264	109.2491	4.1850	14.3506	99.9861	0.9338	
29-69A-1	0.0772	3.4154	206.9904	4.0218	2.3705	17.6234	99.9565	1.0266	
29-69A-2	0.1762	1.0463	2584.1375	6.0781	5.1058	14.8246	99.4282	1.0976	
29-69A-3	0.2629	0.7010	77.6354	4.1903	7.1480	12.7486	99.9810	1.0797	
29-69A-4	0.3650	0.6499	49.7212	2.9338	9.9249	9.6307	99.9866	1.1742	
29-69A-5	0.2295	0.9183	137.3094	3.2461	6.6116	12.9290	99.9675	1.1121	
29-69A-6	0.2012	1.0473	1110.1824	4.4733	5.6702	13.5504	99.7482	1.0735	
29-69A-7	0.2642	0.6976	115.8228	4.2874	7.1582	11.8222	99.9718	1.0185	
29-69A-8	0.1962	1.0742	845.0393	5.5371	5.6551	0.0	99.8091	1.0893	
29-69A-9	0.1732	1.0645	4362.3672	98.0812	4.7850	15.0299	99.0378	1.0681	
29-69A-10	0.1790	0.5879	3335.2832	81.9313	5.1187	14.7434	99.2605	1.0962	
29-69A-11	0.2093	0.1255	958.0417	16.5908	5.9520	14.0173	99.7877	1.1068	
29-69A-12	0.2616	0.0	67.4938	10.7099	7.2094	12.6565	99.9839	1.0931	
29-69A-13	0.2370	0.2219	156.2584	198.6832	6.9662	12.9046	99.9642	1.1585	
29-69A-14	0.2776	0.0947	59.2694	164.2468	7.5475	12.2795	99.9856	1.0932	
29-69A-15	0.2230	0.1179	189.3507	75.7100	6.1680	13.5918	99.9575	1.0810	
29-69A-16	0.1968	0.2645	1359.2986	84.0529	5.3101	14.2566	99.6931	1.0195	
29-69A-17	0.1474	0.3567	1911.2852	250.0754	4.4781	15.0736	99.5736	1.1273	
29-69A-18	0.2040	0.1288	377.1653	94.8285	5.7668	13.8929	99.9111	1.0888	
29-69A-19	0.2509	0.0	0.0	42.9956	7.0997	12.5534	-	-	
29-69A-20	0.2465	0.3200	0.0	28.1271	6.6296	12.9964	99.9998	1.0520	
29-69A-21	0.1380	4.0291	194.0606	341.5737	5.0462	14.8492	99.9411	1.4524	9
29-69A-22	0.1315	1.8031	508.7205	423.3809	4.6267	15.1802	99.8546	1.3944	9
29-69A-23	0.1289	1.6347	399.6960	360.5210	4.6776	15.2110	99.8886	1.4544	9
29-69A-24	0.1334	0.9864	404.8333	297.2791	4.9640	14.9237	99.8853	1.4847	9
29-69A-25	0.2164	0.6080	19.3152	372.6367	7.3672	12.1833	99.9934	1.4785	9
29-69A-26	0.1694	0.4657	90.3951	206.7162	5.5799	14.0595	99.9729	1.3593	9
29-69A-27	0.1825	0.4322	128.2155	217.0396	5.3147	14.2339	99.9545	1.1027	9
29-69A-28	0.2261	0.3489	20.8342	156.1115	6.0734	13.8315	99.9920	1.0543	9
29-69A-29	0.1226	0.6435	797.1111	447.1833	4.0162	15.6461	99.7826	1.3128	9
29-70A-1	0.2429	0.0	5.7093	204.3343	3.2476	16.0686	99.9932	0.9446	
29-70A-2	0.2027	0.2594	7.7024	194.7761	2.7652	16.6781	99.9900	0.9614	
29-70A-3	0.1766	0.2978	5.8854	193.7010	2.4749	17.0607	99.9920	0.9861	
29-70A-4	0.2878	0.0	12.1281	217.8987	3.7374	15.4885	99.9855	0.9206	
29-70A-5	0.3175	0.0	8.2234	241.7932	4.2022	14.7627	99.9902	0.9401	
29-70A-6	0.3728	0.0	6.5333	341.7981	5.0131	13.6030	99.9922	0.9587	
29-70A-7	0.4311	0.0	6.0567	434.3037	5.8027	12.4740	99.9927	0.9634	
29-71A-1	0.2331	0.2256	47.0686	39.6913	3.1501	14.2687	99.9433	0.9555	
29-71A-2	0.2122	0.0	91.0774	43.5364	3.1100	16.0588	99.8918	1.0356	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-71A-3	0.1886	0.0	120.1456	60.3505	2.8178	16.9024	99.8576	1.0550	
29-71A-4	0.1587	0.1656	114.4769	155.6938	2.2970	17.2874	99.8640	1.0198	
29-71A-5	0.1269	0.0	60.3314	234.2844	1.8875	17.7302	99.9286	1.0438	
29-71A-6	0.2386	0.0	39.7761	42.7953	3.5525	15.3352	99.9527	1.0527	
29-71A-7	0.2574	0.0	29.7528	73.6158	3.8400	15.5024	99.9646	1.0008	
29-71A-8	0.2284	0.1151	47.2260	71.6012	3.3500	16.1917	99.9435	1.0367	
29-71A-9	0.1972	0.2666	100.9775	59.9532	2.9261	16.1855	99.8793	1.0478	
29-71A-10	0.1646	0.3194	211.6655	51.5873	2.4764	16.9521	99.7484	1.0625	
29-71A-11	0.1355	0.3880	219.0792	73.7296	2.1442	17.4985	99.7399	1.1155	
29-71A-12	0.1078	0.7316	141.8217	149.2403	1.7323	17.6519	99.8303	1.1283	
29-71A-13	0.1046	0.7539	106.6125	140.4096	1.5761	17.7626	99.8718	1.0569	
29-71A-14	0.1319	0.1993	186.8324	62.1772	1.9109	17.2298	99.7787	1.0208	
29-71A-15	0.1593	0.3300	218.6893	39.0357	2.2600	16.8549	99.7401	1.0019	
29-71A-16	0.1856	0.1416	197.9047	34.7787	2.6454	16.1723	99.7649	1.0080	
29-71A-17	0.2462	0.3204	77.3450	33.0484	3.3822	15.7988	99.9069	0.9729	
29-71A-18	0.2207	0.3574	251.9788	32.0666	3.0113	16.5735	99.6994	0.9688	
29-71A-19	0.1949	0.5400	455.1169	44.5769	2.6783	16.8400	99.4584	0.9793	
29-71A-20	0.1689	0.4672	482.6416	96.6640	2.3334	17.2158	99.4270	0.9834	
29-71A-21	0.1434	0.5503	314.2749	216.1376	2.0229	17.3156	99.6267	0.9981	
29-71A-22	0.2640	0.0995	60.7862	114.9621	3.6381	15.5132	99.9272	0.9764	
29-71A-23	0.2407	0.0	118.0701	89.0153	3.2379	15.9891	99.8595	0.9534	
29-71A-24	0.2081	0.1263	318.7822	71.9544	2.8109	16.4647	99.6211	0.9601	
29-71A-25	0.1748	0.1503	510.0159	73.7681	2.5223	16.8071	99.3954	1.0272	
29-71A-26	0.2130	0.2469	200.5353	55.8429	2.8639	16.4347	99.7610	0.9533	
29-71A-27	0.1860	0.5656	1154.4539	53.3970	2.5503	16.8946	98.6297	0.9935	
29-71A-28	0.1569	0.6706	1160.2231	82.0342	2.2181	17.3113	98.6252	1.0218	
29-71A-29	0.1351	0.9736	461.1294	190.1554	1.9406	17.6947	99.4520	1.0186	
29-71A-30	0.1086	1.2117	234.8825	356.2866	1.6444	17.8672	99.7190	1.0661	
29-71A-31	0.1718	0.6126	623.7004	57.1450	2.4027	16.9087	99.2594	0.9990	
29-71A-32	0.2016	0.3914	341.7144	73.2267	2.7230	16.5443	99.5932	0.9603	
29-71A-33	0.1787	0.5887	1075.3457	51.9145	2.3852	17.1004	98.7240	0.9654	
29-71A-34	0.0990	1.5950	1220.6440	77.4557	1.3778	18.2161	98.5563	1.0036	
29-71A-35	0.0805	3.6029	225.0699	673.3137	1.0885	18.5569	99.7231	0.9503	
29-71A-36	0.0999	2.3750	335.8179	113.8264	1.3895	18.2543	99.5963	0.9819	
29-71A-37	0.1017	2.0729	370.5828	88.4238	1.4128	18.2121	99.5563	0.9816	
29-71A-38	0.1193	1.7660	444.9829	60.6644	1.6554	17.9630	99.4690	0.9830	
29-71A-39	0.1082	1.4601	426.4419	66.9147	1.5499	18.0396	99.4923	1.0136	
29-71A-40	0.1140	1.6172	443.9722	63.9479	1.6936	17.9247	99.4709	1.0516	
29-71A-41	0.1726	0.0	153.8599	289.1628	2.5793	16.6893	99.8178	1.0545	
29-71A-43	0.2016	0.5143	333.1541	347.1321	2.9845	16.0817	99.6030	1.0514	
29-71A-44	0.2346	0.0	792.3352	131.1086	3.3571	15.6034	99.0577	1.0303	
29-71A-45	0.2659	0.0	814.0601	62.0633	3.6870	15.1552	99.0298	1.0016	
29-71A-46	0.2916	0.0	411.0071	41.1302	4.1022	14.5419	99.5093	1.0075	
29-71A-47	0.3276	0.0	134.2607	32.9665	4.5447	13.9909	99.8393	0.9893	
29-71A-48	0.3558	0.0	64.4261	31.5814	4.9461	13.6104	99.9227	0.9913	
29-71A-49	0.1784	0.4357	273.1157	437.2539	2.7483	16.1518	99.6750	1.0905	
29-71A-50	0.2120	0.0	772.4260	238.6563	3.1520	15.6223	99.0828	1.0675	
29-71A-51	0.2494	0.0	923.6973	91.1192	3.5435	15.1742	98.9004	1.0272	
29-71A-52	0.2969	0.0	681.8230	51.9556	3.8526	14.7887	99.1857	0.9372	
29-71A-53	0.3212	0.0	192.8682	52.8335	4.3493	14.2950	99.7693	0.9666	
29-71A-54	0.2951	0.0	456.1465	50.0355	4.0411	14.4090	99.4553	0.9825	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCC15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-72A-1	0.3564	0.2213	40.3892	35.0578	4.9837	13.5971	99.9508	0.9965	
29-72A-2	0.2875	0.2744	109.1334	31.9695	3.8433	15.0708	99.8688	0.9501	
29-72A-3	0.2564	0.1025	141.7212	31.1666	3.3867	15.8091	99.8309	0.9377	
29-72A-4	0.2179	0.0	154.0333	35.2755	3.0431	16.7256	99.8170	0.9887	
29-72A-5	0.1891	0.0	406.4404	31.7794	2.6829	16.8076	99.5181	1.0091	
29-72A-6	0.1571	0.1673	1075.9478	28.3763	2.2456	17.3833	98.7266	1.0307	
29-72A-7	0.1227	0.4286	1545.0444	31.2363	1.8271	17.4415	98.1750	1.0820	
29-72A-8	0.0934	0.8447	1337.9687	101.5924	1.4611	18.1960	98.4212	1.1272	3
29-72A-9	0.2694	0.0	101.2971	131.0396	3.3822	15.5972	99.8792	0.8912	
29-72A-10	0.2307	0.1139	173.6843	136.5941	3.0885	16.1529	99.7931	0.9494	
29-72A-11	0.1866	0.0	392.9739	126.4945	2.7241	16.3197	99.5341	1.0267	
29-72A-12	0.1543	0.3407	1128.9702	79.0535	2.2178	17.0862	98.6635	1.0373	
29-72A-13	0.1145	0.4592	2050.5994	72.3247	1.7710	17.4502	97.5796	1.1339	3
29-72A-14	0.0834	0.9458	1158.5308	101.1407	1.3668	18.0246	98.6332	1.1739	3
29-72A-15	0.0988	0.5322	1378.3281	73.1453	1.5928	17.8480	98.3741	1.1622	3
29-73A-1	0.0656	0.0	0.0	116.1877	0.0	19.0706	-	-	
29-73A-2	0.0808	0.0	0.0	48.9960	0.0	18.8790	-	-	
29-73A-3	0.0504	0.0	0.0	225.8618	0.0	19.3227	-	-	
29-73A-4	0.0359	0.0	0.0	184.2576	0.0	19.5333	-	-	
29-73A-5	0.0488	0.0	0.0	344.1248	0.0	19.2173	-	-	
29-73A-6	0.0636	0.0	0.0	122.2782	0.0	18.9782	-	-	
29-73A-7	0.0820	0.0	0.0	0.0	1.1946	18.7820	-	1.0181	
29-73A-8	0.0701	0.0	0.0	120.3602	1.0232	18.8591	-	1.0186	
29-73A-9	0.0906	0.0	0.0	46.9961	1.2582	18.6364	-	0.9710	
29-73A-10	0.1029	0.0	0.0	37.5651	1.4324	18.3392	-	0.9745	
29-73A-11	0.0466	0.0	0.0	287.7004	0.7611	19.0260	-	1.0394	
29-73A-12	0.0531	0.0	0.0	338.0684	0.7964	18.8962	-	1.0402	
29-73A-13	0.0677	0.0	0.0	173.0079	0.9516	18.6736	-	0.9826	
29-73A-14	0.0793	0.0	0.0	69.4551	1.0771	18.6550	-	0.9965	
29-73A-15	0.0875	0.0	0.0	44.1162	1.1901	18.5436	-	0.9509	
29-73A-16	0.0929	0.0	0.0	39.8345	1.2628	18.4136	-	0.9503	
29-73A-17	0.0693	0.0	0.0	118.4035	0.9740	18.7664	-	0.9868	
29-73A-18	0.0801	0.0	0.0	58.0727	1.1222	18.6364	-	0.9790	
29-73A-19	0.0873	0.0	0.0	44.2035	1.1810	18.5993	-	0.9455	
29-73A-20	0.0927	0.0	0.0	41.6599	1.2810	18.5250	-	0.9647	
29-73A-21	0.0918	0.0	0.0	43.7928	1.2719	18.5250	-	0.9685	
29-73A-22	0.1130	0.0	0.0	43.9302	1.5481	18.1905	-	0.9296	
29-73A-23	0.0755	0.0	0.0	115.6803	1.0996	18.7478	-	1.0176	
29-74A-1	0.1708	0.9249	148.6309	247.0356	2.4461	17.0248	99.8209	1.0108	
29-74A-2	0.2029	0.7784	213.1071	339.3306	2.7183	16.6375	99.7445	0.9494	
29-74A-3	0.2316	0.4543	694.7468	181.0525	3.1113	16.1141	99.1724	0.9658	
29-74A-4	0.2609	0.3023	916.9448	71.7403	3.5175	15.7152	98.9066	0.9764	
29-74A-5	0.2910	0.0903	745.5066	39.1278	3.9691	15.3773	99.1097	0.9854	
29-74A-6	0.3219	0.0	403.8015	32.0262	4.3926	14.6812	99.5169	0.9795	
29-74A-7	0.3498	0.0	187.8600	31.8068	4.8023	14.0586	99.7748	0.9817	
29-74A-8	0.1763	0.2982	221.5706	400.2603	2.5545	16.6867	99.7365	1.0245	
29-74A-9	0.2104	0.1249	502.1267	322.8037	2.8534	16.2399	99.4034	0.9687	
29-74A-10	0.2481	0.1059	1051.5425	99.8020	3.3365	15.7527	98.7479	0.9768	
29-74A-11	0.2852	0.0	997.2058	53.6539	3.7106	15.4899	98.6100	0.9469	
29-74A-12	0.3180	0.0	830.3252	44.2657	3.8791	15.0201	99.0070	0.8870	
29-74A-13	0.3455	0.0	273.3308	79.9904	4.5774	14.0586	99.6725	0.9493	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-75A-1	0.1974	0.8001	153.0952	197.4308	2.4167	17.0763	99.8157	0.8661	12
29-75A-2	0.2313	0.4548	506.2153	153.0164	2.8183	16.5530	99.3966	0.8727	12
29-75A-3	0.2613	0.2012	877.4932	76.8481	3.1929	16.0285	98.9539	0.8864	12
29-75A-4	0.3030	0.0867	916.8977	42.6733	3.6216	15.5029	98.9042	0.8710	12
29-75A-5	0.3350	0.0785	875.0732	32.2937	4.0329	15.1644	98.9520	0.8779	12
29-75A-6	0.3760	0.0	747.5598	28.6476	4.4197	14.3726	99.1024	0.8568	12
29-75A-7	0.4138	0.0	576.7952	26.5636	4.8797	13.6730	99.3057	0.8573	12
29-75A-8	0.2068	0.5086	1009.7998	97.1445	2.4855	16.5855	98.7996	0.8722	12
29-75A-9	0.2463	0.2135	1245.4619	46.5242	2.8937	15.9535	98.5169	0.8614	12
29-75A-10	0.2876	0.1828	1203.2905	73.4494	3.2800	15.6156	98.5632	0.8383	12
29-75A-11	0.3284	0.1601	1105.6978	99.0146	3.5799	15.0514	98.6761	0.8024	12
29-75A-12	0.2662	0.0987	1294.6750	71.5332	3.0524	15.6719	98.4567	0.8444	12
29-75A-13	0.2298	0.0	1338.6096	50.8279	2.7183	16.1597	98.4086	0.8685	12
29-75A-14	0.1645	0.1598	545.8884	155.5758	2.3628	16.5904	99.3533	1.0231	
29-76A-1	0.0952	0.0	0.0	35.7242	1.3495	18.2935	-	0.9915	
29-76A-2	0.0838	0.0	0.0	41.5087	1.2081	18.4788	-	1.0079	
29-76A-3	0.0724	0.0	0.0	68.7377	1.0501	18.7166	-	1.0128	
29-76A-4	0.0541	0.0	0.0	200.3018	0.8586	18.9388	-	1.1065	
29-76A-5	0.0548	0.0	0.0	330.0483	0.8233	18.8675	-	1.0475	
29-76A-6	0.0696	0.0	0.0	70.2554	1.0098	18.6825	-	1.0130	
29-76A-7	0.0852	0.0	0.0	35.9899	1.2306	18.3676	-	1.0096	
29-76A-8	0.0747	0.0	0.0	55.9147	1.0009	18.6425	-	0.9354	
29-76A-9	0.0647	0.0	0.0	117.5184	0.8896	18.8490	-	0.9598	
29-76A-10	0.0515	0.0	0.0	248.7840	0.7749	18.9970	-	1.0460	
29-76A-11	0.0442	0.0	0.0	258.7473	0.6699	19.0894	-	1.0562	
29-76A-12	0.0515	0.0	0.0	241.7872	0.7486	18.9600	-	1.0132	
29-76A-13	0.0629	0.0	0.0	107.4807	0.8852	18.8120	-	0.9827	
29-76A-14	0.0702	0.0	0.0	66.2753	0.9518	18.7565	-	0.9467	
29-76A-15	0.0359	0.0	0.0	160.2145	0.6134	19.1263	-	1.1866	3
29-76A-16	0.0493	0.0	0.0	135.6559	0.7048	19.0709	-	0.9976	
29-76A-17	0.0599	0.0	0.0	77.6289	0.8101	18.9415	-	0.9437	
29-76A-18	0.0669	0.0	0.0	49.4058	0.9074	18.8675	-	0.9414	
29-77A-1	0.1394	0.7215	198.6171	65.9918	2.1973	17.1553	99.7629	1.1105	
29-77A-2	0.1718	0.4391	163.9296	66.1136	2.5941	16.7308	99.8044	1.0660	
29-77A-3	0.2354	0.2135	148.0527	134.8315	3.5175	15.4899	99.8232	1.0591	
29-77A-4	0.2948	0.0	324.2891	404.9856	4.3385	14.4241	99.6128	1.0514	
29-77A-5	0.3545	0.0	1398.4082	124.9525	4.9517	13.3855	98.3234	1.0295	
29-77A-6	0.4149	0.1818	1804.3938	36.5827	5.8047	12.0953	97.8273	1.0453	
29-77A-7	0.4453	0.0564	1818.2471	27.8953	6.3157	11.6764	97.8066	1.0617	
29-77A-8	0.4746	0.0529	1723.7864	24.7967	6.7654	10.6644	97.9165	1.0666	
29-77A-9	0.5054	0.0497	1618.7964	25.5681	7.5154	9.6867	98.0394	1.1104	
29-77A-10	0.3504	0.2152	1003.5864	247.8726	4.7748	13.4233	98.7964	0.9948	
29-77A-11	0.4084	0.0615	1792.0073	63.4108	5.6556	12.2664	97.8436	1.0345	
29-77A-12	0.4355	0.1154	1878.4719	42.7459	6.1229	11.5048	97.7352	1.0536	
29-77A-13	0.4658	0.1079	1756.1038	40.3314	6.4982	11.0850	97.8785	1.0448	
29-77A-14	0.4454	0.0564	1836.7866	37.0793	6.1636	11.4858	97.7842	1.0375	
29-77A-15	0.5404	0.2329	1331.5781	131.8970	8.0539	8.9750	98.3828	1.1081	
29-77A-16	0.2973	0.2653	246.2454	48.4784	4.6149	14.3730	99.7050	1.1068	
29-77A-17	0.3355	0.1567	152.5577	39.9934	5.2254	13.5235	99.8168	1.1110	
29-77A-18	0.2307	0.6847	353.4675	314.7612	3.0705	16.1590	99.5774	0.9485	
29-77A-19	0.2790	0.1884	451.6721	74.6690	3.9627	15.1262	99.4606	1.0172	

TABLE A-2
EMISSION CONCENTRATION AND GAS ANALYSIS PARAMETER DATA (Continued)

SCHEME	EQR	HCQ15	CMQ15	NXCQ15	CDQ1	OXQ1	EFFGA	CFRAC	NOTE
29-77A-20	0.3017	0.1743	390.7573	47.3988	4.3376	14.5050	99.5326	1.0297	
29-77A-21	0.3243	0.0810	292.7578	37.9161	4.8682	13.5613	99.6494	1.0736	
29-77A-22	0.3474	0.0757	239.7956	35.7396	5.3043	13.1642	99.7124	1.0925	
29-77A-23	0.3131	0.1679	316.2068	38.7402	4.6862	13.9586	99.6214	1.0703	
29-77A-24	0.2084	0.7579	201.4353	354.3191	2.8338	16.0090	99.7583	0.9635	
29-77A-25	0.1606	0.8190	65.4165	128.7078	2.2192	16.9080	99.9198	0.9723	
29-77A-26	0.1099	1.4376	47.0727	85.0936	1.6447	17.4686	99.9397	1.0494	
29-77A-27	0.3975	0.1984	236.3294	37.6880	6.1666	11.8748	99.7152	1.1134	
29-77A-28	0.4224	0.1244	318.6392	37.2094	6.4491	11.5803	99.6158	1.0998	
29-77A-29	0.3741	0.1405	227.9116	37.4971	5.7315	12.4460	99.7259	1.0979	
29-77A-30	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-77A-31	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-77A-32	0.0	0.0	0.0	0.0	0.0	0.0	-	-	
29-77A-33	0.0	0.0	0.0	0.0	0.0	0.0			

NOTE:

1 - Fuel flow meter inoperative; EQR, HCQ15, CMQ15, and NXCQ15 calculated from FASAM

2 - Water in sample line

3 - Fuel flow below calibrated range

4 - CO reading above calibrated range

5 - Sample line saturated with fuel

6 - Unstable combustion

7 - Backflow of fuel from pilot

8 - Emission data not simultaneously recorded with performance data

9 - Indicated fuel flow did not agree with measured nozzle pressure drop

10 - Secondary zone fuel flow readout not functioning properly

11 - CO_2 and O_2 analyzers out of cal

12 - Nonrepresentative exhaust sample; probe located just aft of combustor exit

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
01-05A-1	0.0845	0.0	652.0000	619.0000	542.0000	0.0056	0.0058	0.0	0.0058
01-05A-2	0.1247	0.0	676.0000	640.0000	557.0000	0.0081	0.0086	0.0	0.0086
01-05A-3	0.1753	0.0	685.0000	658.0000	556.0000	0.0107	0.0120	0.0	0.0120
01-05A-4	0.1858	0.0	679.0000	653.0000	547.0000	0.0117	0.0128	0.0	0.0128
01-05A-5	0.1415	0.0	652.0000	618.0000	538.0000	0.0090	0.0097	0.0	0.0097
01-05A-6	0.1095	0.0	660.0000	628.0000	543.0000	0.0078	0.0075	0.0	0.0075
01-06A-1	0.1123	0.0	722.0000	614.0000	500.0000	0.0073	0.0077	0.0	0.0077
01-06A-2	0.1456	0.0	731.0000	620.0000	501.0000	0.0092	0.0100	0.0	0.0100
01-06A-3	0.1780	0.0	734.0000	624.0000	500.0000	0.0111	0.0122	0.0	0.0122
01-07A-1	0.1798	0.0	617.0000	642.0000	590.0000	0.0116	0.0124	0.0	0.0124
01-07A-2	0.2252	0.0	627.0000	665.0000	588.0000	0.0146	0.0155	0.0	0.0155
01-07A-3	0.1463	0.0	617.0000	630.0000	600.0000	0.0096	0.0101	0.0	0.0101
01-07A-4	0.2786	0.0	634.0000	687.0000	592.0000	0.0177	0.0192	0.0	0.0192
01-07A-5	0.3397	0.0	622.0000	668.0000	576.0000	0.0219	0.0234	0.0	0.0234
01-07A-6	0.3896	0.0	626.0000	660.0000	580.0000	0.0252	0.0268	0.0	0.0268
01-07A-7	0.2264	0.0	626.0000	673.0000	585.0000	0.0151	0.0156	0.0	0.0156
01-07A-8	0.1779	0.0	619.0000	646.0000	592.0000	0.0117	0.0122	0.0	0.0122
01-07A-9	0.1206	0.0	629.0000	624.0000	590.0000	0.0088	0.0083	0.0	0.0083
01-07A-10	0.3971	0.0	725.0000	875.0000	574.0000	0.0268	0.0273	0.0	0.0273
01-07A-11	0.1922	0.0	592.0000	602.0000	576.0000	0.0126	0.0132	0.0	0.0132
01-07A-12	0.1431	0.0	596.0000	612.0000	580.0000	0.0099	0.0098	0.0	0.0098
01-07A-13	0.1766	0.0	614.0000	641.0000	590.0000	0.0121	0.0122	0.0	0.0122
01-07A-14	0.2291	0.0	617.0000	660.0000	582.0000	0.0152	0.0158	0.0	0.0158
01-07A-15	0.2749	0.0	619.0000	671.0000	583.0000	0.0187	0.0189	0.0	0.0189
01-07A-16	0.3283	0.0	621.0000	670.0000	581.0000	0.0217	0.0226	0.0	0.0226
01-07A-17	0.3756	0.0	622.0000	667.0000	580.0000	0.0261	0.0258	0.0	0.0258
01-07A-18	0.1489	0.0	606.0000	621.0000	588.0000	0.0102	0.0102	0.0	0.0102
01-07A-19	0.2400	0.0	692.0000	778.0000	571.0000	0.0176	0.0165	0.0	0.0165
01-07A-20	0.3243	0.0	680.0000	828.0000	569.0000	0.0226	0.0223	0.0	0.0223
01-07A-21	0.3611	0.0	685.0000	825.0000	575.0000	0.0262	0.0248	0.0	0.0248
01-07A-22	0.1690	0.0	646.0000	667.0000	572.0000	0.0130	0.0116	0.0	0.0116
01-08A-1	0.1204	0.0	747.0000	640.0000	624.0000	0.0079	0.0083	0.0	0.0083
01-08A-2	0.1752	0.0	898.0000	678.0000	650.0000	0.0113	0.0121	0.0	0.0121
01-08A-3	0.2284	0.0	1128.0000	752.0000	667.0000	0.0147	0.0157	0.0	0.0157
01-08A-4	0.2829	0.0	1204.0000	798.0000	715.0000	0.0183	0.0195	0.0	0.0195
01-08A-5	0.3367	0.0	1229.0000	806.0000	722.0000	0.0220	0.0232	0.0	0.0232
01-08A-6	0.2295	0.0	1128.0000	758.0000	686.0000	0.0149	0.0158	0.0	0.0158
01-08A-7	0.2430	0.0	1012.0000	704.0000	705.0000	0.0147	0.0167	0.0086	0.0081
01-08A-8	0.2997	0.0	1126.0000	744.0000	778.0000	0.0185	0.0206	0.0086	0.0120
01-08A-9	0.3538	0.0	1190.0000	782.0000	776.0000	0.0220	0.0243	0.0087	0.0157
01-08A-10	0.1833	0.0	934.0000	676.0000	661.0000	0.0113	0.0126	0.0043	0.0083
01-08A-11	0.2376	0.0	1032.0000	708.0000	703.0000	0.0148	0.0163	0.0044	0.0120
01-08A-12	0.2953	0.0	1168.0000	770.0000	764.0000	0.0185	0.0203	0.0046	0.0157
01-08A-13	0.3491	0.0	1231.0000	804.0000	755.0000	0.0218	0.0240	0.0046	0.0194
01-08A-14	0.3938	0.0	1314.0000	867.0000	758.0000	0.0245	0.0271	0.0049	0.0222
01-08A-15	0.4069	0.0	1264.0000	855.0000	713.0000	0.0251	0.0280	0.0086	0.0194
01-08A-16	0.3355	0.0	1184.0000	814.0000	746.0000	0.0216	0.0231	0.0	0.0231
01-08A-17	0.1733	0.0	878.0000	674.0000	678.0000	0.0111	0.0119	0.0	0.0119
01-09A-1	0.0934	0.0	662.0000	590.0000	616.0000	0.0065	0.0064	0.0	0.0064
01-09A-2	0.1477	0.0	759.0000	591.0000	698.0000	0.0098	0.0102	0.0	0.0102
01-09A-3	0.2029	0.0	784.0000	606.0000	677.0000	0.0134	0.0140	0.0	0.0140

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FADX1	FADX2
01-09A-4	0.2580	0.0	810.0000	614.0000	675.0000	0.0169	0.0178	0.0	0.0178
01-09A-5	0.3121	0.0	878.0000	629.0000	658.0000	0.0207	0.0215	0.0	0.0215
01-09A-6	0.3643	0.0	936.0000	636.0000	656.0000	0.0240	0.0251	0.0	0.0251
01-09A-7	0.1195	0.0	720.0000	584.0000	650.0000	0.0080	0.0082	0.0	0.0082
01-09A-8	0.1060	0.0	679.0000	590.0000	616.0000	0.0070	0.0073	0.0	0.0073
01-09A-9	0.1204	0.0	704.0000	593.0000	635.0000	0.0078	0.0083	0.0	0.0083
01-09A-10	0.1734	0.0	874.0000	612.0000	737.0000	0.0114	0.0119	0.0	0.0119
01-09A-11	0.1116	0.0	792.0000	596.0000	732.0000	0.0080	0.0077	0.0	0.0077
01-09A-12	0.2521	0.0	931.0000	630.0000	739.0000	0.0181	0.0173	0.0	0.0173
01-09A-13	0.3109	0.0	1004.0000	649.0000	699.0000	0.0215	0.0214	0.0	0.0214
01-09A-14	0.3705	0.0	1121.0000	609.0000	675.0000	0.0253	0.0255	0.0	0.0255
01-09A-15	0.1965	0.0	742.0000	599.0000	640.0000	0.0126	0.0135	0.0	0.0135
01-09A-16	0.3021	0.0	857.0000	628.0000	663.0000	0.0195	0.0208	0.0	0.0208
01-10A-1	0.1207	0.0	728.0000	585.0000	632.0000	0.0082	0.0083	0.0	0.0083
01-10A-2	0.1753	0.0	844.0000	592.0000	650.0000	0.0116	0.0121	0.0	0.0121
01-10A-3	0.2297	0.0	1016.0000	600.0000	700.0000	0.0152	0.0158	0.0	0.0158
01-10A-4	0.2836	0.0	1138.0000	598.0000	659.0000	0.0187	0.0195	0.0	0.0195
01-10A-5	0.3344	0.0	1507.0000	592.0000	645.0000	0.0220	0.0230	0.0	0.0230
01-10A-6	0.3636	0.0	1354.0000	604.0000	636.0000	0.0238	0.0250	0.0	0.0250
01-10A-7	0.1211	0.0	802.0000	588.0000	642.0000	0.0081	0.0083	0.0	0.0083
01-10B-8	0.3406	0.0	1348.0000	621.0000	649.0000	0.0224	0.0234	0.0	0.0234
02-01A-1	0.4672	0.0	0.0	0.0	0.0	0.0299	0.0	0.0	0.0
02-01B-1	0.3875	0.0	0.0	0.0	0.0	0.0248	0.0	0.0	0.0
02-01B-2	0.3469	0.0	0.0	0.0	0.0	0.0222	0.0	0.0	0.0
02-01B-3	0.4062	0.0	0.0	0.0	0.0	0.0260	0.0	0.0	0.0
02-01B-4	0.2627	1794.0000	1528.0000	1907.0000	0.0	0.0194	0.0168	0.0168	0.0
02-01B-5	0.2360	1799.0000	1544.0000	1849.0000	0.0	0.0164	0.0151	0.0151	0.0
02-01B-6	0.3624	1732.0000	1507.0000	1927.0000	0.0	0.0210	0.0232	0.0232	0.0
02-01B-7	0.1753	1305.0000	1226.0000	1693.0000	0.0	0.0124	0.0121	0.0	0.0121
02-01B-8	0.1956	1401.0000	1280.0000	1857.0000	0.0	0.0138	0.0135	0.0	0.0135
02-01B-9	0.1669	1423.0000	1293.0000	1839.0000	0.0	0.0132	0.0115	0.0	0.0115
02-01B-10	0.1618	1208.0000	1102.0000	1506.0000	0.0	0.0120	0.0111	0.0	0.0111
02-01B-11	0.1295	0.0	1185.0000	0.0	0.0	0.0100	0.0089	0.0089	0.0
02-01B-12	0.2699	0.0	0.0	0.0	0.0	0.0192	0.0186	0.0186	0.0
02-01B-13	0.2468	0.0	0.0	0.0	0.0	0.0163	0.0170	0.0170	0.0
02-01B-14	0.2512	0.0	0.0	0.0	0.0	0.0157	0.0173	0.0173	0.0
03-03A-1	0.0819	652.0000	653.0000	829.0000	652.0000	0.0064	0.0056	0.0056	0.0
03-03A-2	0.0989	672.0000	679.0000	974.0000	689.0000	0.0079	0.0068	0.0068	0.0
03-03A-3	0.1129	698.0000	715.0000	1125.0000	725.0000	0.0092	0.0078	0.0078	0.0
03-03A-4	0.1272	730.0000	773.0000	1297.0000	838.0000	0.0103	0.0088	0.0088	0.0
03-03A-5	0.0989	678.0000	683.0000	1020.0000	714.0000	0.0081	0.0068	0.0068	0.0
03-04A-1	0.0567	646.0000	695.0000	784.0000	742.0000	0.0051	0.0039	0.0039	0.0
03-04A-2	0.0737	673.0000	740.0000	887.0000	823.0000	0.0062	0.0051	0.0051	0.0
03-04A-3	0.0849	699.0000	808.0000	968.0000	896.0000	0.0072	0.0058	0.0058	0.0
03-04A-4	0.0993	718.0000	1208.0000	1068.0000	961.0000	0.0081	0.0068	0.0068	0.0
03-04A-5	0.1130	740.0000	1508.0000	1161.0000	1042.0000	0.0088	0.0078	0.0078	0.0
03-04A-6	0.1273	742.0000	1627.0000	1166.0000	1109.0000	0.0099	0.0088	0.0088	0.0
03-05A-1	0.0991	626.0000	0.0	842.0000	611.0000	0.0044	0.0068	0.0068	0.0
03-05A-2	0.1147	619.0000	0.0	873.0000	619.0000	0.0062	0.0078	0.0078	0.0
03-05A-3	0.1266	716.0000	0.0	1102.0000	987.0000	0.0095	0.0087	0.0087	0.0
03-05A-4	0.1402	732.0000	0.0	1255.0000	1199.0000	0.0102	0.0096	0.0096	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
03-06A-1	0.0847	0.0	714.0000	905.0000	776.0000	0.0069	0.0058	0.0058	0.0
03-06A-2	0.0533	0.0	680.0000	724.0000	648.0000	0.0039	0.0037	0.0037	0.0
03-06A-3	0.0730	0.0	1145.0000	878.0000	722.0000	0.0059	0.0050	0.0050	0.0
03-06A-4	0.0843	0.0	1273.0000	943.0000	836.0000	0.0066	0.0058	0.0058	0.0
03-06A-5	0.0984	0.0	1438.0000	1070.0000	948.0000	0.0076	0.0068	0.0068	0.0
03-06A-6	0.1124	0.0	1567.0000	1206.0000	1018.0000	0.0086	0.0077	0.0077	0.0
03-06A-7	0.0559	0.0	673.0000	739.0000	637.0000	0.0040	0.0038	0.0038	0.0
04-01A-1	0.1030	620.0000	775.0000	755.0000	715.0000	0.0	0.0071	0.0071	0.0
04-01A-2	0.2611	620.0000	614.0000	450.0000	665.0000	0.0	0.0180	0.0084	0.0096
04-01A-3	0.2659	630.0000	770.0000	575.0000	765.0000	0.0	0.0183	0.0084	0.0099
04-01A-4	0.1101	618.0000	855.0000	840.0000	780.0000	0.0	0.0076	0.0076	0.0
04-02A-1	0.1281	635.0000	975.0000	920.0000	815.0000	0.0	0.0088	0.0088	0.0
04-02A-2	0.3612	625.0000	990.0000	850.0000	860.0000	0.0	0.0248	0.0111	0.0138
04-02A-3	0.3253	630.0000	620.0000	400.0000	0.0	0.0	0.0224	0.0084	0.0140
04-02A-4	0.3672	630.0000	940.0000	845.0000	965.0000	0.0	0.0253	0.0092	0.0160
04-02A-5	0.1487	620.0000	1480.0000	1345.0000	1150.0000	0.0	0.0102	0.0102	0.0
04-03A-1	0.0648	625.0000	1240.0000	1130.0000	1040.0000	0.0	0.0045	0.0045	0.0
04-03A-2	0.2291	630.0000	1160.0000	1180.0000	1440.0000	0.0	0.0158	0.0067	0.0090
04-03A-3	0.1567	620.0000	1215.0000	1350.0000	1275.0000	0.0	0.0108	0.0083	0.0025
04-03A-4	0.2113	0.0	1270.0000	1595.0000	1335.0000	0.0	0.0145	0.0081	0.0064
04-04A-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-04A-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-04A-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
04-05A-29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-05A-34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-06A-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-07A-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-07A-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-07A-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-07A-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04-07A-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05-01A-1	0.1521	705.0000	615.0000	646.0000	670.0000	0.0091	0.0105	0.0105	0.0
05-01A-2	0.2189	880.0000	645.0000	700.0000	698.0000	0.0082	0.0151	0.0151	0.0
05-01A-3	0.2641	610.0000	645.0000	670.0000	640.0000	0.0109	0.0182	0.0182	0.0
05-01A-4	0.3252	488.0000	625.0000	618.0000	620.0000	0.0120	0.0224	0.0224	0.0
05-01A-5	0.3806	485.0000	625.0000	618.0000	625.0000	0.0118	0.0262	0.0262	0.0
05-01A-6	0.3736	490.0000	630.0000	620.0000	630.0000	0.0128	0.0257	0.0257	0.0
05-01A-7	0.3226	505.0000	635.0000	625.0000	635.0000	0.0096	0.0222	0.0222	0.0
05-01A-8	0.3753	488.0000	635.0000	620.0000	628.0000	0.0123	0.0258	0.0258	0.0
05-01A-9	0.3162	505.0000	638.0000	620.0000	630.0000	0.0091	0.0218	0.0218	0.0
05-01A-10	0.2653	510.0000	625.0000	615.0000	622.0000	0.0072	0.0183	0.0183	0.0
05-02A-1	0.1644	670.0000	670.0000	670.0000	800.0000	0.0	0.0113	0.0113	0.0
05-02A-2	0.3654	790.0000	783.0000	650.0000	965.0000	0.0	0.0251	0.0251	0.0
05-02A-3	0.3963	833.0000	793.0000	780.0000	985.0000	0.0	0.0273	0.0273	0.0
05-02A-4	0.8092	985.0000	835.0000	795.0000	1135.0000	0.0	0.0557	0.0557	0.0
05-03A-1	0.1602	1200.0000	805.0000	855.0000	0.0	0.0	0.0110	0.0110	0.0
05-03A-3	0.3111	1090.0000	740.0000	780.0000	0.0	0.0	0.0214	0.0214	0.0
05-03A-3	0.4208	1145.0000	750.0000	795.0000	0.0	0.0	0.0289	0.0289	0.0
05-04A-1	0.1698	620.0000	622.0000	595.0000	632.0000	0.0113	0.0117	0.0	0.0117
05-04A-2	0.2475	620.0000	620.0000	515.0000	650.0000	0.0174	0.0170	0.0	0.0170
05-04A-3	0.3061	630.0000	630.0000	510.0000	650.0000	0.0205	0.0211	0.0	0.0211
05-04A-4	0.2920	638.0000	635.0000	520.0000	0.0	0.0199	0.0201	0.0	0.0201
05-04A-5	0.2128	610.0000	610.0000	500.0000	0.0	0.0125	0.0146	0.0	0.0146
05-04A-6	0.2351	590.0000	795.0000	1045.0000	650.0000	0.0124	0.0162	0.0045	0.0116
05-04A-7	0.2701	590.0000	830.0000	1000.0000	655.0000	0.0156	0.0186	0.0045	0.0141
05-04A-8	0.2819	580.0000	825.0000	1100.0000	645.0000	0.0185	0.0194	0.0044	0.0150
05-04A-9	0.3111	570.0000	1070.0000	1310.0000	660.0000	0.0196	0.0214	0.0043	0.0171
05-05A-1	0.2408	620.0000	615.0000	610.0000	840.0000	0.0174	0.0166	0.0	0.0166
05-05A-2	0.2190	620.0000	615.0000	610.0000	785.0000	0.0141	0.0151	0.0	0.0151

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-05A-3	0.1884	623.0000	620.0000	610.0000	750.0000	0.0120	0.0130	0.0	0.0130
05-05A-4	0.1383	625.0000	620.0000	610.0000	645.0000	0.0070	0.0095	0.0	0.0095
05-05A-5	0.1631	625.0000	620.0000	615.0000	750.0000	0.0102	0.0112	0.0	0.0112
05-05A-6	0.2772	625.0000	625.0000	620.0000	870.0000	0.0223	0.0191	0.0	0.0191
05-05A-7	0.1884	625.0000	625.0000	615.0000	785.0000	0.0131	0.0130	0.0	0.0130
05-05A-8	0.2469	625.0000	620.0000	615.0000	865.0000	0.0171	0.0170	0.0	0.0170
05-05A-9	0.2771	625.0000	620.0000	615.0000	890.0000	0.0169	0.0191	0.0	0.0191
05-05B-1	0.0560	630.0000	635.0000	810.0000	0.0	0.0012	0.0039	0.0039	0.0
05-05B-2	0.0691	610.0000	635.0000	1100.0000	0.0	0.0026	0.0048	0.0048	0.0
05-05B-3	0.0477	620.0000	625.0000	790.0000	0.0	0.0012	0.0033	0.0033	0.0
05-05B-4	0.0550	605.0000	625.0000	910.0000	0.0	0.0019	0.0038	0.0038	0.0
05-05B-5	0.0697	625.0000	665.0000	1050.0000	0.0	0.0024	0.0048	0.0048	0.0
05-05B-6	0.0756	635.0000	690.0000	1325.0000	0.0	0.0033	0.0052	0.0052	0.0
05-05B-7	0.0470	620.0000	645.0000	1000.0000	0.0	0.0020	0.0032	0.0032	0.0
05-05B-8	0.0551	615.0000	655.0000	1130.0000	0.0	0.0025	0.0038	0.0038	0.0
05-05B-9	0.0691	615.0000	675.0000	1375.0000	0.0	0.0034	0.0048	0.0048	0.0
05-05C-1	0.1411	615.0000	610.0000	600.0000	650.0000	0.0099	0.0097	0.0	0.0097
05-05C-2	0.1963	610.0000	660.0000	655.0000	0.0	0.0102	0.0135	0.0039	0.0096
05-05C-3	0.2526	620.0000	670.0000	650.0000	705.0000	0.0138	0.0174	0.0039	0.0135
05-05C-4	0.2280	615.0000	665.0000	650.0000	0.0	0.0136	0.0157	0.0039	0.0118
05-05C-5	0.2800	610.0000	660.0000	650.0000	1120.0000	0.0156	0.0193	0.0039	0.0154
05-05C-6	0.2932	615.0000	710.0000	775.0000	785.0000	0.0171	0.0202	0.0047	0.0154
05-05C-7	0.2609	615.0000	720.0000	785.0000	0.0	0.0149	0.0180	0.0047	0.0132
05-05C-8	0.2420	618.0000	735.0000	805.0000	815.0000	0.0132	0.0167	0.0047	0.0119
05-05C-9	0.2041	620.0000	750.0000	850.0000	685.0000	0.0111	0.0140	0.0048	0.0093
05-05C-10	0.1990	615.0000	675.0000	1190.0000	625.0000	0.0065	0.0137	0.0048	0.0089
05-05C-11	0.2450	640.0000	740.0000	1225.0000	635.0000	0.0070	0.0169	0.0048	0.0121
05-05C-12	0.2760	645.0000	760.0000	1190.0000	650.0000	0.0075	0.0190	0.0046	0.0143
05-05C-13	0.3071	615.0000	735.0000	1185.0000	665.0000	0.0105	0.0211	0.0046	0.0165
05-05C-14	0.3153	625.0000	740.0000	1330.0000	675.0000	0.0083	0.0217	0.0052	0.0165
05-06A-1	0.1578	600.0000	600.0000	605.0000	630.0000	0.0065	0.0109	0.0	0.0109
05-06A-2	0.1874	590.0000	585.0000	595.0000	640.0000	0.0090	0.0129	0.0	0.0129
05-06A-3	0.1871	600.0000	600.0000	623.0000	660.0000	0.0076	0.0129	0.0	0.0129
05-06A-4	0.2210	620.0000	610.0000	780.0000	690.0000	0.0098	0.0152	0.0	0.0152
05-07A-1	0.2154	540.0000	605.0000	625.0000	770.0000	0.0136	0.0148	0.0038	0.0111
05-07A-2	0.3103	575.0000	610.0000	605.0000	1460.0000	0.0187	0.0214	0.0037	0.0176
05-07A-3	0.0445	550.0000	620.0000	615.0000	630.0000	0.0017	0.0031	0.0031	0.0
05-07A-4	0.3084	550.0000	595.0000	595.0000	765.0000	0.0177	0.0212	0.0037	0.0175
05-07A-5	0.3104	550.0000	605.0000	605.0000	750.0000	0.0181	0.0214	0.0037	0.0176
05-07A-6	0.3358	550.0000	600.0000	600.0000	770.0000	0.0196	0.0231	0.0037	0.0194
05-07A-7	0.2417	575.0000	615.0000	615.0000	750.0000	0.0126	0.0166	0.0037	0.0130
05-07A-8	0.3171	625.0000	615.0000	617.0000	750.0000	0.0184	0.0218	0.0021	0.0197
05-07A-9	0.2898	560.0000	600.0000	600.0000	715.0000	0.0177	0.0199	0.0022	0.0178
05-07A-10	0.2185	550.0000	600.0000	600.0000	765.0000	0.0129	0.0150	0.0021	0.0129
05-07A-11	0.1878	550.0000	605.0000	730.0000	745.0000	0.0102	0.0129	0.0021	0.0108
05-07A-12	0.1564	550.0000	605.0000	703.0000	720.0000	0.0079	0.0108	0.0021	0.0087
05-07A-13	0.1289	602.0000	600.0000	625.0000	685.0000	0.0063	0.0089	0.0	0.0089
05-07A-14	0.0299	1010.0000	910.0000	835.0000	650.0000	0.0021	0.0021	0.0021	0.0
05-07A-15	0.0157	625.0000	615.0000	755.0000	655.0000	0.0010	0.0011	0.0011	0.0
05-08A-1	0.0151	680.0000	860.0000	655.0000	630.0000	0.0000	0.0010	0.0010	0.0
05-09A-1	0.0106	1190.0000	1265.0000	620.0000	595.0000	0.0008	0.0007	0.0007	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-09A-2	0.1841	995.0000	1180.0000	650.0000	690.0000	0.0121	0.0127	0.0017	0.0110
05-09A-3	0.1917	1185.0000	1505.0000	625.0000	680.0000	0.0124	0.0132	0.0022	0.0110
05-09A-4	0.2191	1115.0000	1390.0000	630.0000	695.0000	0.0140	0.0151	0.0022	0.0129
05-09A-5	0.2855	1070.0000	1360.0000	625.0000	700.0000	0.0159	0.0196	0.0028	0.0168
05-09A-6	0.3287	1015.0000	1320.0000	620.0000	740.0000	0.0194	0.0226	0.0030	0.0197
05-09A-7	0.3203	785.0000	1150.0000	590.0000	695.0000	0.0191	0.0220	0.0030	0.0191
05-09A-8	0.2912	815.0000	1135.0000	625.0000	725.0000	0.0168	0.0200	0.0031	0.0169
05-09A-9	0.2297	800.0000	1055.0000	648.0000	690.0000	0.0122	0.0158	0.0031	0.0127
05-09A-10	0.2046	835.0000	1100.0000	685.0000	680.0000	0.0104	0.0141	0.0031	0.0110
05-09A-11	0.1324	970.0000	1400.0000	830.0000	650.0000	0.0055	0.0091	0.0031	0.0060
05-09A-12	0.1265	990.0000	1210.0000	745.0000	635.0000	0.0050	0.0087	0.0027	0.0060
05-09A-13	0.1439	825.0000	815.0000	645.0000	650.0000	0.0062	0.0099	0.0035	0.0064
05-10A-1	0.1271	1037.0000	1559.0000	618.0000	639.0000	0.0080	0.0087	0.0018	0.0070
05-10A-2	0.1600	996.0000	1568.0000	606.0000	659.0000	0.0072	0.0110	0.0018	0.0092
05-10A-3	0.2102	999.0000	1480.0000	616.0000	678.0000	0.0127	0.0145	0.0027	0.0117
05-10A-4	0.2684	732.0000	1005.0000	594.0000	695.0000	0.0153	0.0185	0.0030	0.0155
05-10A-5	0.2348	745.0000	996.0000	593.0000	668.0000	0.0132	0.0162	0.0030	0.0131
05-10B-1	0.0140	721.0000	1129.0000	619.0000	603.0000	0.0010	0.0010	0.0010	0.0
05-10B-2	0.0174	716.0000	1242.0000	609.0000	587.0000	0.0013	0.0012	0.0012	0.0
05-10B-3	0.0202	741.0000	1312.0000	625.0000	600.0000	0.0014	0.0014	0.0014	0.0
05-10B-4	0.0254	774.0000	1281.0000	634.0000	603.0000	0.0016	0.0017	0.0017	0.0
05-10B-5	0.0313	825.0000	1269.0000	650.0000	609.0000	0.0021	0.0022	0.0022	0.0
05-10B-6	0.0379	838.0000	1274.0000	671.0000	611.0000	0.0023	0.0026	0.0026	0.0
05-10B-7	0.0438	860.0000	1004.0000	721.0000	620.0000	0.0025	0.0030	0.0030	0.0
05-10B-8	0.0487	774.0000	956.0000	783.0000	611.0000	0.0030	0.0034	0.0034	0.0
05-11A-1	0.0224	1537.0000	1639.0000	1650.0000	613.0000	0.0011	0.0015	0.0015	0.0
05-11A-2	0.0252	1585.0000	1525.0000	1573.0000	640.0000	0.0012	0.0017	0.0017	0.0
05-11A-3	0.0135	1428.0000	1493.0000	1561.0000	614.0000	0.0010	0.0009	0.0009	0.0
05-11A-4	0.0167	1463.0000	1501.0000	1531.0000	631.0000	0.0011	0.0011	0.0011	0.0
05-11A-5	0.0193	1450.0000	1422.0000	1445.0000	627.0000	0.0013	0.0013	0.0013	0.0
05-11A-6	0.0221	1296.0000	1216.0000	1305.0000	639.0000	0.0015	0.0015	0.0015	0.0
05-11A-7	0.1165	1437.0000	1444.0000	1595.0000	616.0000	0.0080	0.0080	0.0012	0.0069
05-11A-8	0.1857	1436.0000	1410.0000	1580.0000	617.0000	0.0125	0.0128	0.0012	0.0116
05-11A-9	0.2379	1527.0000	1405.0000	1603.0000	623.0000	0.0158	0.0164	0.0011	0.0152
05-11A-10	0.0169	1099.0000	1346.0000	1525.0000	627.0000	0.0013	0.0012	0.0012	0.0
05-11A-11	0.1138	1113.0000	1276.0000	1505.0000	616.0000	0.0082	0.0078	0.0011	0.0067
05-11A-12	0.1121	1101.0000	1260.0000	1498.0000	616.0000	0.0080	0.0077	0.0012	0.0065
05-11B-1	0.0166	1546.0000	1841.0000	1637.0000	641.0000	0.0013	0.0011	0.0011	0.0
05-11B-2	0.2915	1499.0000	1872.0000	1634.0000	639.0000	0.0199	0.0201	0.0012	0.0189
05-11B-3	0.3191	1489.0000	1873.0000	1648.0000	646.0000	0.0215	0.0220	0.0012	0.0208
05-11B-4	0.2421	1495.0000	1872.0000	1616.0000	628.0000	0.0165	0.0167	0.0012	0.0155
05-11B-5	0.1830	1480.0000	1858.0000	1599.0000	624.0000	0.0126	0.0126	0.0012	0.0114
05-11B-6	0.1583	1447.0000	1839.0000	1562.0000	624.0000	0.0110	0.0109	0.0012	0.0097
05-11B-7	0.1170	1480.0000	1720.0000	1410.0000	622.0000	0.0083	0.0080	0.0012	0.0069
05-11B-8	0.1358	1584.0000	1230.0000	926.0000	618.0000	0.0096	0.0093	0.0012	0.0082
05-11C-1	0.1357	1571.0000	1776.0000	1613.0000	618.0000	0.0095	0.0093	0.0009	0.0084
05-11C-2	0.0675	1705.0000	1860.0000	1303.0000	634.0000	0.0052	0.0046	0.0012	0.0034
05-11C-3	0.1200	1741.0000	1754.0000	1074.0000	621.0000	0.0086	0.0083	0.0012	0.0070
05-11C-4	0.1773	1712.0000	1868.0000	1215.0000	623.0000	0.0122	0.0122	0.0012	0.0110
05-11C-5	0.2283	1724.0000	1716.0000	1158.0000	612.0000	0.0156	0.0157	0.0012	0.0145
05-11C-6	0.2900	1670.0000	1906.0000	1517.0000	627.0000	0.0187	0.0200	0.0012	0.0187

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-11C-7	0.2678	1708.0000	1858.0000	1429.0000	604.0000	0.0165	0.0184	0.0012	0.0172
05-11C-8	0.1547	1558.0000	1889.0000	1640.0000	630.0000	0.0110	0.0106	0.0012	0.0095
05-11C-9	0.1811	1579.0000	1885.0000	1605.0000	621.0000	0.0126	0.0125	0.0012	0.0113
05-11C-10	0.2417	1579.0000	1886.0000	1661.0000	625.0000	0.0166	0.0166	0.0012	0.0155
05-11C-11	0.2972	1581.0000	1888.0000	1619.0000	622.0000	0.0199	0.0204	0.0012	0.0192
05-11C-12	0.2153	1421.0000	1780.0000	1629.0000	631.0000	0.0142	0.0148	0.0012	0.0136
05-11C-13	0.1044	1525.0000	1803.0000	1567.0000	627.0000	0.0074	0.0072	0.0012	0.0060
05-11C-14	0.2122	1544.0000	1811.0000	1570.0000	616.0000	0.0139	0.0146	0.0012	0.0134
05-11C-15	0.0732	1454.0000	1844.0000	1551.0000	631.0000	0.0058	0.0050	0.0012	0.0038
05-11C-16	0.1288	1454.0000	1824.0000	1539.0000	616.0000	0.0093	0.0089	0.0012	0.0077
05-11C-17	0.3180	1460.0000	1824.0000	1597.0000	617.0000	0.0226	0.0219	0.0003	0.0215
05-11C-18	0.0785	1848.0000	1940.0000	1577.0000	815.0000	0.0061	0.0054	0.0011	0.0043
05-11C-19	0.1501	1920.0000	1851.0000	1423.0000	819.0000	0.0107	0.0103	0.0016	0.0088
05-11C-20	0.2071	1933.0000	1941.0000	1384.0000	812.0000	0.0144	0.0143	0.0015	0.0128
05-11C-21	0.2697	1941.0000	1909.0000	1298.0000	809.0000	0.0188	0.0186	0.0015	0.0171
05-11C-22	0.0650	1950.0000	1928.0000	1394.0000	934.0000	0.0052	0.0045	0.0013	0.0032
05-11C-23	0.1110	1860.0000	1975.0000	1584.0000	816.0000	0.0083	0.0076	0.0013	0.0063
05-11C-24	0.2648	1910.0000	1989.0000	1600.0000	809.0000	0.0183	0.0182	0.0013	0.0170
05-11C-25	0.3295	1933.0000	1943.0000	1463.0000	804.0000	0.0224	0.0227	0.0015	0.0212
05-11C-26	0.2068	1977.0000	1890.0000	1337.0000	812.0000	0.0147	0.0142	0.0015	0.0127
05-11C-27	0.1414	1890.0000	1940.0000	1442.0000	814.0000	0.0101	0.0097	0.0015	0.0082
05-11C-28	0.2358	1882.0000	1937.0000	1431.0000	804.0000	0.0160	0.0162	0.0015	0.0148
05-11C-29	0.2966	1911.0000	1888.0000	1315.0000	796.0000	0.0200	0.0204	0.0015	0.0190
05-11C-30	0.0848	1906.0000	1908.0000	1431.0000	811.0000	0.0065	0.0058	0.0014	0.0044
05-11C-31	0.1435	1904.0000	1936.0000	1473.0000	811.0000	0.0100	0.0099	0.0015	0.0084
05-11C-32	0.2033	1879.0000	1959.0000	1513.0000	811.0000	0.0140	0.0140	0.0013	0.0126
05-11C-33	0.2640	1891.0000	1970.0000	1531.0000	802.0000	0.0180	0.0182	0.0013	0.0168
05-11C-34	0.1747	1906.0000	1860.0000	1332.0000	805.0000	0.0121	0.0120	0.0015	0.0105
05-11C-35	0.1132	1793.0000	1991.0000	1569.0000	814.0000	0.0080	0.0078	0.0015	0.0063
05-11C-36	0.2642	1813.0000	1539.0000	1426.0000	809.0000	0.0176	0.0182	0.0014	0.0168
05-12A-1	0.2012	0.0	0.0	678.0000	1052.0000	0.0101	0.0117	0.0117	0.0
05-12A-2	0.2732	0.0	0.0	672.0000	925.0000	0.0142	0.0159	0.0159	0.0
05-12A-3	0.3515	0.0	0.0	665.0000	921.0000	0.0186	0.0204	0.0204	0.0
05-12A-4	0.4883	0.0	0.0	642.0000	878.0000	0.0261	0.0284	0.0284	0.0
05-12A-5	0.4216	0.0	0.0	632.0000	933.0000	0.0230	0.0245	0.0245	0.0
05-12A-6	0.3915	0.0	0.0	639.0000	883.0000	0.0207	0.0227	0.0227	0.0
05-12A-7	0.3526	0.0	0.0	650.0000	918.0000	0.0187	0.0205	0.0205	0.0
05-12A-8	0.3134	0.0	0.0	652.0000	901.0000	0.0158	0.0182	0.0182	0.0
05-12A-9	0.2924	0.0	0.0	658.0000	901.0000	0.0150	0.0170	0.0170	0.0
05-12A-10	0.2764	246.0300	0.0	381.0000	582.0000	0.0156	0.0161	0.0161	0.0
05-12A-11	0.3108	301.0000	0.0	496.0000	842.0000	0.0150	0.0181	0.0181	0.0
05-12A-12	0.4216	294.0000	0.0	483.0000	794.0000	0.0244	0.0245	0.0245	0.0
05-12A-13	0.5742	267.0000	0.0	479.0000	686.0000	0.0356	0.0334	0.0334	0.0
05-12A-14	0.3524	307.0000	0.0	483.0000	845.0000	0.0199	0.0205	0.0205	0.0
05-12A-15	0.2496	319.0000	0.0	504.0000	847.0000	0.0140	0.0145	0.0145	0.0
05-12A-16	0.2143	315.0000	0.0	476.0000	885.0000	0.0119	0.0124	0.0124	0.0
05-12A-17	0.1798	323.0000	0.0	473.0000	853.0000	0.0098	0.0104	0.0104	0.0
05-12A-18	0.1946	327.0000	0.0	479.0000	887.0000	0.0108	0.0113	0.0113	0.0
05-12A-19	0.2138	327.0000	0.0	488.0000	907.0000	0.0121	0.0124	0.0124	0.0
05-12A-20	0.1616	326.0000	0.0	464.0000	779.0000	0.0089	0.0094	0.0094	0.0
05-12A-21	0.1434	328.0000	0.0	658.0000	950.0000	0.0078	0.0083	0.0083	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-12B-1	0.1896	243.0000	589.0000	469.0000	1007.0000	0.0099	0.0110	0.0110	0.0
05-12B-2	0.2282	247.0000	586.0000	526.0000	1205.0000	0.0115	0.0133	0.0133	0.0
05-12B-3	0.2589	251.0000	588.0000	503.0000	1010.0000	0.0140	0.0150	0.0150	0.0
05-12B-4	0.2948	256.0000	595.0000	536.0000	1315.0000	0.0156	0.0171	0.0171	0.0
05-12B-5	0.3464	259.0000	592.0000	567.0000	1185.0000	0.0184	0.0201	0.0201	0.0
05-12B-6	0.4023	290.0000	592.0000	634.0000	1250.0000	0.0214	0.0234	0.0234	0.0
05-12B-7	0.2109	315.0000	778.0000	526.0000	1350.0000	0.0102	0.0123	0.0123	0.0
05-12B-8	0.1425	321.0000	787.0000	592.0000	978.0000	0.0069	0.0083	0.0083	0.0
05-12B-9	0.1700	326.0000	783.0000	671.0000	1488.0000	0.0080	0.0099	0.0099	0.0
05-12B-10	0.2494	325.0000	780.0000	615.0000	1235.0000	0.0126	0.0145	0.0145	0.0
05-12B-11	0.2871	333.0000	784.0000	497.0000	1140.0000	0.0149	0.0167	0.0167	0.0
05-12B-12	0.3361	329.0000	781.0000	675.0000	1434.0000	0.0172	0.0195	0.0195	0.0
05-12B-13	0.3789	332.0000	773.0000	829.0000	1249.0000	0.0196	0.0220	0.0220	0.0
05-13A-1	0.1274	391.0000	940.0000	256.0000	510.0000	0.0067	0.0074	0.0074	0.0
05-13A-2	0.1623	607.0000	1275.0000	1537.0000	542.0000	0.0081	0.0094	0.0094	0.0
05-13A-3	0.1603	610.0000	1356.0000	1356.0000	867.0000	0.0084	0.0093	0.0093	0.0
05-13A-4	0.1919	590.0000	614.0000	563.0000	994.0000	0.0100	0.0111	0.0111	0.0
05-13A-5	0.2209	600.0000	612.0000	564.0000	1040.0000	0.0113	0.0128	0.0128	0.0
05-13A-6	0.2809	598.0000	608.0000	554.0000	1031.0000	0.0146	0.0163	0.0163	0.0
05-13A-7	0.3136	591.0000	598.0000	545.0000	1016.0000	0.0167	0.0182	0.0182	0.0
05-13A-8	0.4120	594.0000	657.0000	540.0000	987.0000	0.0225	0.0239	0.0239	0.0
05-13A-9	0.3540	597.0000	658.0000	549.0000	973.0000	0.0191	0.0206	0.0206	0.0
05-13A-10	0.3023	603.0000	652.0000	562.0000	963.0000	0.0166	0.0176	0.0176	0.0
05-13A-11	0.2833	600.0000	648.0000	563.0000	945.0000	0.0149	0.0165	0.0165	0.0
05-13A-12	0.2389	600.0000	636.0000	567.0000	939.0000	0.0128	0.0139	0.0139	0.0
05-13A-13	0.2008	589.0000	622.0000	563.0000	904.0000	0.0107	0.0117	0.0117	0.0
05-13A-14	0.1686	593.0000	646.0000	573.0000	856.0000	0.0089	0.0098	0.0098	0.0
05-13A-15	0.3504	591.0000	655.0000	545.0000	961.0000	0.0186	0.0204	0.0204	0.0
05-13A-16	0.2761	586.0000	635.0000	552.0000	935.0000	0.0147	0.0160	0.0160	0.0
05-13A-17	0.1514	804.0000	1535.0000	1746.0000	1068.0000	0.0076	0.0088	0.0088	0.0
05-13A-18	0.2008	792.0000	907.0000	766.0000	1073.0000	0.0103	0.0117	0.0117	0.0
05-13A-19	0.2203	793.0000	828.0000	755.0000	1134.0000	0.0115	0.0128	0.0128	0.0
05-13A-20	0.2445	796.0000	827.0000	755.0000	1172.0000	0.0123	0.0142	0.0142	0.0
05-13A-21	0.2641	789.0000	816.0000	744.0000	1192.0000	0.0133	0.0153	0.0153	0.0
05-13A-22	0.2851	788.0000	809.0000	740.0000	1196.0000	0.0146	0.0166	0.0166	0.0
05-13A-23	0.3068	789.0000	801.0000	736.0000	1202.0000	0.0156	0.0178	0.0178	0.0
05-13A-24	0.3325	789.0000	794.0000	734.0000	1230.0000	0.0172	0.0193	0.0193	0.0
05-13A-25	0.4061	787.0000	778.0000	717.0000	1194.0000	0.0215	0.0236	0.0236	0.0
05-13A-26	0.3590	786.0000	786.0000	726.0000	1215.0000	0.0186	0.0209	0.0209	0.0
05-13A-27	0.2225	590.0000	628.0000	566.0000	1100.0000	0.0113	0.0129	0.0129	0.0
05-13A-29	0.2933	598.0000	597.0000	660.0000	607.0000	0.0146	0.0170	0.0170	0.0
05-14A-1	0.1417	589.0000	1344.0000	650.0000	715.0000	0.0074	0.0082	0.0082	0.0
05-14A-2	0.1676	601.0000	1330.0000	670.0000	739.0000	0.0087	0.0097	0.0097	0.0
05-14A-3	0.2018	578.0000	575.0000	571.0000	704.0000	0.0107	0.0117	0.0117	0.0
05-14A-4	0.2392	582.0000	569.0000	575.0000	732.0000	0.0122	0.0139	0.0139	0.0
05-14A-5	0.2596	590.0000	572.0000	583.0000	763.0000	0.0137	0.0151	0.0151	0.0
05-14A-6	0.2753	593.0000	572.0000	584.0000	780.0000	0.0148	0.0160	0.0160	0.0
05-14A-7	0.3102	587.0000	566.0000	580.0000	810.0000	0.0162	0.0180	0.0180	0.0
05-14A-8	0.3309	582.0000	558.0000	574.0000	825.0000	0.0175	0.0192	0.0192	0.0
05-14A-9	0.3930	585.0000	556.0000	577.0000	859.0000	0.0208	0.0228	0.0228	0.0
05-14A-10	0.1256	804.0000	1559.0000	883.0000	884.0000	0.0069	0.0073	0.0073	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-14A-11	0.1725	786.0000	1473.0000	868.0000	901.0000	0.0090	0.0100	0.0100	0.0
05-14A-12	0.2059	782.0000	776.0000	769.0000	903.0000	0.0112	0.0120	0.0120	0.0
05-14A-13	0.2517	787.0000	764.0000	771.0000	930.0000	0.0135	0.0146	0.0146	0.0
05-14A-14	0.2957	786.0000	758.0000	768.0000	949.0000	0.0158	0.0172	0.0172	0.0
05-14A-15	0.3415	788.0000	754.0000	771.0000	976.0000	0.0188	0.0198	0.0198	0.0
05-14A-16	0.3966	792.0000	741.0000	774.0000	1004.0000	0.0225	0.0230	0.0230	0.0
05-15A-1	0.1361	607.0000	1335.0000	1492.0000	1075.0000	0.0076	0.0079	0.0079	0.0
05-15A-2	0.1703	575.0000	611.0000	562.0000	1002.0000	0.0092	0.0099	0.0099	0.0
05-15A-3	0.2007	584.0000	629.0000	567.0000	1085.0000	0.0112	0.0117	0.0117	0.0
05-15A-4	0.2467	589.0000	674.0000	567.0000	1156.0000	0.0133	0.0143	0.0143	0.0
05-15A-5	0.2875	588.0000	629.0000	567.0000	1212.0000	0.0157	0.0167	0.0167	0.0
05-15A-6	0.3355	588.0000	612.0000	563.0000	1230.0000	0.0185	0.0195	0.0195	0.0
05-15A-7	0.3978	587.0000	619.0000	559.0000	1172.0000	0.0220	0.0231	0.0231	0.0
05-15A-8	0.3566	585.0000	626.0000	557.0000	1204.0000	0.0197	0.0207	0.0207	0.0
05-15A-9	0.1232	801.0000	1602.0000	1314.0000	1208.0000	0.0067	0.0072	0.0072	0.0
05-15A-10	0.1745	802.0000	1543.0000	1545.0000	1314.0000	0.0090	0.0101	0.0101	0.0
05-15A-11	0.2059	788.0000	910.0000	773.0000	1291.0000	0.0111	0.0120	0.0120	0.0
05-15A-12	0.2459	788.0000	871.0000	761.0000	1346.0000	0.0132	0.0143	0.0143	0.0
05-15A-13	0.2922	782.0000	849.0000	749.0000	1374.0000	0.0153	0.0170	0.0170	0.0
05-15A-14	0.3372	780.0000	827.0000	741.0000	1367.0000	0.0183	0.0196	0.0196	0.0
05-15A-15	0.3902	778.0000	789.0000	734.0000	1332.0000	0.0217	0.0227	0.0227	0.0
05-15A-16	0.3655	779.0000	822.0000	736.0000	1344.0000	0.0197	0.0212	0.0212	0.0
05-16A-1	0.1464	631.0000	1659.0000	224.0000	1200.0000	0.0103	0.0101	0.0009	0.0092
05-16A-2	0.1355	610.0000	1569.0000	685.0000	1197.0000	0.0102	0.0093	0.0004	0.0089
05-16A-3	0.1341	613.0000	1548.0000	678.0000	1172.0000	0.0102	0.0092	0.0003	0.0089
05-16A-4	0.1984	616.0000	1503.0000	683.0000	1250.0000	0.0142	0.0136	0.0003	0.0133
05-16A-5	0.2269	619.0000	1515.0000	691.0000	1266.0000	0.0163	0.0156	0.0003	0.0153
05-16A-6	0.2550	617.0000	1481.0000	676.0000	1351.0000	0.0177	0.0175	0.0003	0.0172
05-16A-7	0.2843	607.0000	1462.0000	635.0000	1428.0000	0.0200	0.0196	0.0003	0.0192
05-16A-8	0.3091	605.0000	1528.0000	624.0000	1468.0000	0.0217	0.0213	0.0003	0.0209
05-16A-9	0.3106	608.0000	1544.0000	640.0000	1514.0000	0.0217	0.0214	0.0005	0.0209
05-17A-1	0.0646	990.0000	678.0000	621.0000	819.0000	0.0060	0.0044	0.0003	0.0041
05-17A-2	0.0705	1125.0000	0.0	632.0000	673.0000	0.0061	0.0049	0.0004	0.0045
05-17A-3	0.1293	1131.0000	0.0	617.0000	694.0000	0.0098	0.0089	0.0003	0.0086
05-17A-4	0.1939	1070.0000	0.0	607.0000	762.0000	0.0139	0.0133	0.0003	0.0130
05-17A-5	0.2563	1019.0000	0.0	580.0000	833.0000	0.0176	0.0176	0.0003	0.0173
05-17A-6	0.3248	619.0000	0.0	444.0000	781.0000	0.0217	0.0223	0.0003	0.0220
05-17A-7	0.2537	883.0000	0.0	539.0000	741.0000	0.0175	0.0175	0.0003	0.0171
05-17A-8	0.3193	790.0000	0.0	599.0000	558.0000	0.0209	0.0220	0.0003	0.0216
05-17A-9	0.2561	934.0000	0.0	590.0000	824.0000	0.0172	0.0176	0.0003	0.0173
05-18A-1	0.0828	1622.0000	715.0000	581.0000	544.0000	0.0061	0.0057	0.0009	0.0048
05-18A-2	0.0796	1692.0000	762.0000	585.0000	565.0000	0.0060	0.0055	0.0010	0.0045
05-18A-3	0.1396	1656.0000	642.0000	600.0000	584.0000	0.0099	0.0096	0.0010	0.0086
05-18A-4	0.2031	1600.0000	623.0000	761.0000	596.0000	0.0141	0.0140	0.0010	0.0130
05-18A-5	0.2657	1682.0000	631.0000	714.0000	635.0000	0.0180	0.0183	0.0010	0.0173
05-18A-6	0.3226	1695.0000	615.0000	661.0000	673.0000	0.0215	0.0222	0.0010	0.0212
05-18A-7	0.3531	1671.0000	626.0000	653.0000	689.0000	0.0236	0.0243	0.0009	0.0234
05-18A-8	0.0124	1883.0000	1170.0000	603.0000	566.0000	0.0009	0.0009	0.0009	0.0
05-18A-9	0.0786	1891.0000	785.0000	577.0000	564.0000	0.0054	0.0054	0.0009	0.0045
05-18A-10	0.1997	1786.0000	657.0000	690.0000	623.0000	0.0130	0.0137	0.0008	0.0129
05-19A-1	0.0	556.0000	552.0000	549.0000	519.0000	0.0	0.0	0.0	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-19B-1	0.1369	1454.0000	660.0000	620.0000	662.0000	0.0099	0.0094	0.0009	0.0085
05-19B-2	0.2659	1476.0000	631.0000	999.0000	810.0000	0.0188	0.0183	0.0010	0.0173
05-19B-3	0.3561	1479.0000	624.0000	1003.0000	882.0000	0.0244	0.0245	0.0011	0.0234
05-19B-4	0.0865	1450.0000	712.0000	1067.0000	665.0000	0.0063	0.0060	0.0011	0.0048
05-19B-5	0.1549	0.0	566.0000	680.0000	814.0000	0.0105	0.0107	0.0011	0.0095
05-19B-6	0.1525	1430.0000	655.0000	645.0000	798.0000	0.0105	0.0105	0.0006	0.0099
05-19B-7	0.1395	1336.0000	653.0000	637.0000	732.0000	0.0093	0.0096	0.0008	0.0088
05-19B-8	0.1899	1538.0000	653.0000	657.0000	766.0000	0.0129	0.0131	0.0008	0.0123
05-20A-1	0.0906	880.0000	655.0000	587.0000	890.0000	0.0066	0.0062	0.0011	0.0052
05-20A-2	0.1163	933.0000	642.0000	611.0000	1007.0000	0.0082	0.0080	0.0010	0.0070
05-20A-3	0.1489	882.0000	609.0000	579.0000	1097.0000	0.0102	0.0102	0.0011	0.0092
05-20A-4	0.2313	868.0000	596.0000	581.0000	1303.0000	0.0153	0.0159	0.0023	0.0136
05-21A-1	0.1408	1242.0000	650.0000	605.0000	870.0000	0.0093	0.0097	0.0007	0.0090
05-21A-2	0.1520	1225.0000	626.0000	606.0000	890.0000	0.0101	0.0105	0.0007	0.0098
05-21A-3	0.1202	1241.0000	646.0000	605.0000	851.0000	0.0081	0.0083	0.0006	0.0076
05-21A-4	0.0984	1237.0000	676.0000	607.0000	777.0000	0.0067	0.0068	0.0007	0.0061
05-21A-5	0.0701	1233.0000	710.0000	606.0000	626.0000	0.0048	0.0048	0.0008	0.0041
05-22A-1	0.2087	940.0000	586.0000	577.0000	673.0000	0.0144	0.0144	0.0004	0.0140
05-22A-2	0.2701	955.0000	584.0000	581.0000	708.0000	0.0185	0.0186	0.0004	0.0182
05-22A-3	0.3195	953.0000	580.0000	576.0000	753.0000	0.0218	0.0220	0.0004	0.0216
05-22A-4	0.3708	974.0000	578.0000	578.0000	791.0000	0.0253	0.0255	0.0004	0.0251
05-22A-5	0.1522	971.0000	607.0000	594.0000	631.0000	0.0105	0.0105	0.0004	0.0101
05-23A-1	0.0	576.0000	576.0000	524.0000	556.0000	0.0	0.0	0.0	0.0
05-23A-2	0.0	576.0000	576.0000	571.0000	524.0000	0.0	0.0	0.0	0.0
05-23B-1	0.2168	940.0000	589.0000	578.0000	657.0000	0.0154	0.0149	0.0004	0.0145
05-23B-2	0.2873	945.0000	584.0000	578.0000	703.0000	0.0198	0.0198	0.0004	0.0194
05-23B-3	0.3737	931.0000	583.0000	577.0000	739.0000	0.0262	0.0257	0.0004	0.0253
05-23B-4	0.1550	905.0000	607.0000	594.0000	635.0000	0.0110	0.0107	0.0004	0.0103
05-23B-5	0.0991	867.0000	628.0000	591.0000	591.0000	0.0071	0.0068	0.0004	0.0064
05-23B-6	0.1268	850.0000	603.0000	589.0000	604.0000	0.0090	0.0087	0.0004	0.0083
05-23B-7	0.1811	843.0000	597.0000	598.0000	640.0000	0.0125	0.0125	0.0004	0.0121
05-23B-8	0.0919	951.0000	606.0000	583.0000	579.0000	0.0065	0.0063	0.0003	0.0060
05-23B-9	0.1510	960.0000	596.0000	583.0000	615.0000	0.0105	0.0104	0.0003	0.0100
05-23B-10	0.2000	972.0000	592.0000	582.0000	668.0000	0.0138	0.0138	0.0004	0.0134
05-23B-11	0.2472	962.0000	590.0000	614.0000	708.0000	0.0168	0.0170	0.0004	0.0167
05-23B-12	0.2076	837.0000	576.0000	571.0000	621.0000	0.0140	0.0143	0.0004	0.0139
05-23B-13	0.1574	851.0000	596.0000	586.0000	610.0000	0.0106	0.0108	0.0004	0.0104
05-23B-14	0.1018	847.0000	604.0000	579.0000	571.0000	0.0071	0.0070	0.0004	0.0066
05-23B-15	0.4321	880.0000	573.0000	574.0000	700.0000	0.0286	0.0297	0.0004	0.0293
05-23B-16	0.3039	885.0000	576.0000	568.0000	678.0000	0.0203	0.0209	0.0004	0.0205
05-23B-17	0.2632	877.0000	600.0000	569.0000	657.0000	0.0174	0.0181	0.0004	0.0177
05-23B-18	0.3460	855.0000	572.0000	571.0000	713.0000	0.0229	0.0238	0.0004	0.0234
05-23B-19	0.3878	835.0000	574.0000	573.0000	754.0000	0.0252	0.0267	0.0004	0.0263
05-23B-20	0.2173	860.0000	574.0000	577.0000	648.0000	0.0147	0.0149	0.0005	0.0144
05-23B-21	0.1222	753.0000	576.0000	785.0000	648.0000	0.0088	0.0084	0.0003	0.0081
05-23B-22	0.1674	694.0000	546.0000	784.0000	809.0000	0.0123	0.0115	0.0004	0.0112
05-24A-1	0.0	0.0	0.0	599.0000	593.0000	0.0	0.0	0.0	0.0
05-24B-1	0.1245	0.0	0.0	645.0000	607.0000	0.0089	0.0086	0.0004	0.0082
05-24B-2	0.1525	0.0	0.0	635.0000	608.0000	0.0106	0.0105	0.0004	0.0101
05-25A-1	0.1310	0.0	1280.0000	741.0000	604.0000	0.0086	0.0090	0.0011	0.0079
05-25A-2	0.1669	0.0	1322.0000	729.0000	600.0000	0.0110	0.0115	0.0010	0.0104

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
05-25A-3	0.4052	0.0	1136.0000	621.0000	593.0000	0.0268	0.0279	0.0015	0.0263
05-25A-4	0.3518	0.0	1083.0000	618.0000	590.0000	0.0233	0.0242	0.0011	0.0231
05-25A-5	0.3066	0.0	1250.0000	626.0000	601.0000	0.0202	0.0211	0.0011	0.0200
05-25A-6	0.2585	0.0	1225.0000	634.0000	603.0000	0.0171	0.0178	0.0010	0.0168
05-25A-7	0.2143	0.0	1269.0000	628.0000	604.0000	0.0145	0.0147	0.0011	0.0136
05-25A-8	0.1676	0.0	1222.0000	647.0000	603.0000	0.0111	0.0115	0.0011	0.0105
05-25A-9	0.1298	0.0	1111.0000	658.0000	602.0000	0.0087	0.0089	0.0011	0.0079
05-25A-10	0.4058	0.0	0.0	575.0000	592.0000	0.0266	0.0279	0.0013	0.0266
05-26A-1	0.1553	1040.0000	0.0	1717.0000	0.0	0.0104	0.0107	0.0008	0.0099
05-26A-2	0.2068	1059.0000	0.0	1510.0000	0.0	0.0139	0.0142	0.0008	0.0135
05-26A-3	0.2617	1293.0000	0.0	1274.0000	0.0	0.0174	0.0180	0.0008	0.0172
06-01A-1	0.1756	0.0	1078.0000	0.0	608.0000	0.0094	0.0102	0.0102	0.0
06-01A-2	0.2478	0.0	1151.0000	0.0	629.0000	0.0134	0.0144	0.0144	0.0
06-01A-3	0.3071	0.0	1094.0000	0.0	659.0000	0.0163	0.0178	0.0178	0.0
06-02A-1	0.1756	578.0000	1025.0000	574.0000	591.0000	0.0101	0.0102	0.0102	0.0
06-02A-2	0.2911	560.0000	1123.0000	584.0000	624.0000	0.0154	0.0169	0.0169	0.0
06-03A-1	0.1724	579.0000	770.0000	564.0000	614.0000	0.0099	0.0100	0.0100	0.0
06-03A-2	0.2559	555.0000	1615.0000	567.0000	635.0000	0.0146	0.0149	0.0149	0.0
06-03A-3	0.0880	1694.0000	745.0000	587.0000	611.0000	0.0051	0.0051	0.0051	0.0
06-03A-4	0.1183	1772.0000	745.0000	559.0000	628.0000	0.0105	0.0073	0.0047	0.0025
06-04A-1	0.0659	0.0	1662.0000	622.0000	607.0000	0.0034	0.0038	0.0038	0.0
06-05A-1	0.0844	947.0000	665.0000	626.0000	593.0000	0.0047	0.0049	0.0049	0.0
06-05A-2	0.1190	924.0000	682.0000	637.0000	614.0000	0.0059	0.0069	0.0069	0.0
06-05A-3	0.1611	645.0000	672.0000	624.0000	630.0000	0.0084	0.0094	0.0094	0.0
06-05A-4	0.2251	609.0000	665.0000	618.0000	655.0000	0.0116	0.0131	0.0131	0.0
06-05A-5	0.2786	609.0000	673.0000	623.0000	677.0000	0.0140	0.0162	0.0162	0.0
06-05A-6	0.0539	1105.0000	673.0000	635.0000	586.0000	0.0042	0.0031	0.0031	0.0
06-05A-7	0.0659	1188.0000	678.0000	634.0000	591.0000	0.0048	0.0038	0.0038	0.0
06-05A-8	0.0783	1100.0000	686.0000	640.0000	597.0000	0.0054	0.0045	0.0045	0.0
06-05A-9	0.0914	1078.0000	690.0000	638.0000	598.0000	0.0060	0.0053	0.0053	0.0
06-05A-10	0.1278	1070.0000	666.0000	697.0000	607.0000	0.0112	0.0082	0.0030	0.0053
06-05A-11	0.1393	1089.0000	670.0000	697.0000	605.0000	0.0120	0.0089	0.0038	0.0051
06-05A-12	0.1521	1076.0000	678.0000	699.0000	614.0000	0.0127	0.0096	0.0046	0.0051
06-05A-13	0.1623	1069.0000	683.0000	701.0000	613.0000	0.0136	0.0102	0.0053	0.0049
06-05A-14	0.1911	1040.0000	695.0000	699.0000	626.0000	0.0155	0.0119	0.0068	0.0051
06-05A-15	0.1101	1021.0000	696.0000	632.0000	605.0000	0.0072	0.0064	0.0064	0.0
06-05A-16	0.1189	984.0000	657.0000	595.0000	563.0000	0.0083	0.0069	0.0069	0.0
06-05A-17	0.1567	1004.0000	691.0000	768.0000	607.0000	0.0129	0.0094	0.0071	0.0023
06-05A-18	0.1880	1000.0000	696.0000	703.0000	612.0000	0.0157	0.0116	0.0073	0.0043
06-05A-19	0.2052	1004.0000	693.0000	684.0000	616.0000	0.0172	0.0128	0.0073	0.0055
06-05A-20	0.2192	998.0000	693.0000	683.0000	618.0000	0.0187	0.0137	0.0073	0.0065
06-05A-21	0.2337	1005.0000	695.0000	686.0000	625.0000	0.0201	0.0147	0.0073	0.0074
06-05A-22	0.1248	998.0000	696.0000	625.0000	595.0000	0.0088	0.0072	0.0072	0.0
06-05A-23	0.0766	1060.0000	678.0000	625.0000	586.0000	0.0060	0.0044	0.0044	0.0
06-05A-24	0.0895	1030.0000	675.0000	637.0000	602.0000	0.0059	0.0052	0.0052	0.0
06-05A-25	0.1502	1040.0000	673.0000	698.0000	616.0000	0.0120	0.0094	0.0051	0.0042
06-05A-26	0.1331	1035.0000	684.0000	724.0000	621.0000	0.0110	0.0082	0.0049	0.0033
06-05A-27	0.1247	1037.0000	683.0000	730.0000	624.0000	0.0104	0.0077	0.0049	0.0027
06-05A-28	0.1151	1035.0000	675.0000	714.0000	610.0000	0.0095	0.0070	0.0049	0.0022
06-05A-29	0.0612	626.0000	623.0000	663.0000	586.0000	0.0062	0.0042	0.0	0.0042
06-05A-30	0.0475	631.0000	628.0000	680.0000	586.0000	0.0051	0.0033	0.0	0.0033

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EGR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
07-01A-1	0.0	582.0000	584.0000	505.0000	561.0000	0.0	0.0	0.0	0.0
07-02A-1	0.2074	0.0	560.0000	0.0	0.0	0.0150	0.0143	0.0	0.0143
07-02A-2	0.2251	0.0	564.0000	0.0	0.0	0.0160	0.0155	0.0038	0.0116
07-02A-3	0.2718	0.0	566.0000	0.0	0.0	0.0189	0.0187	0.0042	0.0145
07-02A-4	0.2529	0.0	561.0000	0.0	0.0	0.0179	0.0174	0.0041	0.0133
07-02A-5	0.2210	0.0	561.0000	0.0	0.0	0.0144	0.0152	0.0036	0.0117
07-02B-1	0.2071	0.0	556.0000	0.0	841.0000	0.0146	0.0142	0.0	0.0142
07-02B-2	0.1744	0.0	569.0000	0.0	791.0000	0.0127	0.0120	0.0	0.0120
07-02B-3	0.1661	0.0	566.0000	0.0	729.0000	0.0121	0.0114	0.0	0.0114
07-02B-4	0.2688	0.0	572.0000	0.0	900.0000	0.0195	0.0185	0.0045	0.0140
07-02B-5	0.2668	0.0	574.0000	0.0	870.0000	0.0172	0.0184	0.0042	0.0141
07-02B-6	0.2369	0.0	574.0000	0.0	796.0000	0.0163	0.0163	0.0042	0.0121
07-02B-7	0.3272	0.0	569.0000	0.0	865.0000	0.0217	0.0225	0.0084	0.0141
07-02B-8	0.2983	0.0	566.0000	0.0	881.0000	0.0203	0.0205	0.0081	0.0124
07-02B-9	0.2044	0.0	569.0000	0.0	806.0000	0.0145	0.0141	0.0	0.0141
07-03A-1	0.2357	0.0	564.0000	0.0	1622.0000	0.0171	0.0162	0.0	0.0162
07-03A-2	0.2140	0.0	566.0000	0.0	1594.0000	0.0157	0.0147	0.0	0.0147
07-03A-3	0.2419	0.0	557.0000	0.0	1651.0000	0.0179	0.0166	0.0	0.0166
07-03A-4	0.2237	0.0	562.0000	0.0	1592.0000	0.0162	0.0154	0.0	0.0154
07-03A-5	0.2000	0.0	565.0000	0.0	1576.0000	0.0149	0.0138	0.0	0.0138
07-03A-6	0.1789	0.0	567.0000	0.0	1364.0000	0.0132	0.0123	0.0	0.0123
07-03A-7	0.1920	0.0	567.0000	0.0	1437.0000	0.0141	0.0132	0.0	0.0132
07-03A-8	0.2353	0.0	536.0000	0.0	1128.0000	0.0162	0.0162	0.0	0.0162
07-03A-9	0.2186	0.0	538.0000	0.0	1096.0000	0.0148	0.0150	0.0	0.0150
07-03A-10	0.2012	0.0	559.0000	0.0	930.0000	0.0141	0.0138	0.0	0.0138
07-03A-11	0.2319	0.0	546.0000	0.0	1136.0000	0.0161	0.0160	0.0	0.0160
07-03A-12	0.2002	0.0	547.0000	0.0	936.0000	0.0141	0.0138	0.0	0.0138
07-03A-13	0.2013	0.0	556.0000	0.0	926.0000	0.0138	0.0139	0.0	0.0139
07-03A-14	0.2854	0.0	553.0000	0.0	772.0000	0.0197	0.0196	0.0061	0.0136
07-03A-15	0.2812	0.0	552.0000	0.0	758.0000	0.0194	0.0193	0.0055	0.0138
07-03A-16	0.3065	0.0	538.0000	0.0	1152.0000	0.0209	0.0211	0.0056	0.0155
07-03A-17	0.3161	0.0	540.0000	0.0	1291.0000	0.0221	0.0217	0.0054	0.0163
07-04A-1	0.2125	0.0	577.0000	0.0	812.0000	0.0149	0.0146	0.0	0.0146
07-05A-1	0.2529	0.0	501.0000	0.0	1118.0000	0.0172	0.0174	0.0	0.0174
07-05A-2	0.2291	0.0	501.0000	0.0	1009.0000	0.0164	0.0158	0.0	0.0158
07-05A-3	0.2237	0.0	499.0000	0.0	964.0000	0.0155	0.0154	0.0	0.0154
07-05A-4	0.2165	0.0	508.0000	0.0	951.0000	0.0148	0.0149	0.0	0.0149
07-06A-1	0.2573	0.0	593.0000	0.0	1400.0000	0.0178	0.0177	0.0	0.0177
07-06A-2	0.2370	0.0	580.0000	0.0	1400.0000	0.0167	0.0163	0.0	0.0163
07-06A-3	0.2154	0.0	594.0000	0.0	1387.0000	0.0153	0.0148	0.0	0.0148
07-06A-4	0.2096	0.0	596.0000	0.0	1364.0000	0.0147	0.0144	0.0	0.0144
07-06A-5	0.2049	0.0	590.0000	0.0	1360.0000	0.0142	0.0141	0.0	0.0141
07-06A-6	0.1966	0.0	592.0000	0.0	1346.0000	0.0138	0.0135	0.0	0.0135
07-06A-7	0.1890	0.0	596.0000	0.0	1316.0000	0.0137	0.0130	0.0	0.0130
07-06A-8	0.1771	0.0	593.0000	0.0	1233.0000	0.0125	0.0122	0.0	0.0122
07-06A-9	0.2625	0.0	589.0000	0.0	1522.0000	0.0183	0.0181	0.0	0.0181
07-06A-10	0.2420	0.0	585.0000	0.0	1500.0000	0.0170	0.0166	0.0	0.0166
07-06A-11	0.2219	0.0	586.0000	0.0	1478.0000	0.0155	0.0153	0.0	0.0153
07-06A-12	0.2009	0.0	585.0000	0.0	1047.0000	0.0141	0.0138	0.0	0.0138
07-06A-13	0.1883	0.0	585.0000	0.0	1118.0000	0.0130	0.0130	0.0	0.0130
07-07A-1	0.2460	0.0	597.0000	0.0	0.0	0.0173	0.0169	0.0	0.0169

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
07-07A-2	0.2261	0.0	592.0000	0.0	0.0	0.0156	0.0156	0.0	0.0156
07-07A-3	0.2038	0.0	579.0000	0.0	0.0	0.0143	0.0140	0.0	0.0140
07-07A-4	0.1857	0.0	582.0000	0.0	0.0	0.0127	0.0128	0.0	0.0128
07-07A-5	0.2699	0.0	589.0000	0.0	0.0	0.0180	0.0186	0.0	0.0186
07-07A-6	0.2469	0.0	592.0000	0.0	0.0	0.0165	0.0170	0.0	0.0170
07-07A-7	0.2232	0.0	596.0000	0.0	0.0	0.0148	0.0154	0.0	0.0154
07-07A-8	0.1991	0.0	587.0000	0.0	0.0	0.0132	0.0137	0.0	0.0137
07-07A-9	0.1997	0.0	594.0000	0.0	0.0	0.0136	0.0137	0.0	0.0137
07-07A-10	0.1876	0.0	583.0000	0.0	0.0	0.0128	0.0129	0.0	0.0129
07-07A-11	0.1743	0.0	587.0000	0.0	0.0	0.0118	0.0120	0.0	0.0120
07-07A-12	0.1668	0.0	588.0000	0.0	0.0	0.0113	0.0115	0.0	0.0115
07-07A-13	0.1603	0.0	591.0000	0.0	0.0	0.0108	0.0110	0.0	0.0110
07-07A-14	0.1565	0.0	590.0000	0.0	0.0	0.0105	0.0108	0.0	0.0108
07-07A-15	0.2540	0.0	582.0000	0.0	0.0	0.0166	0.0175	0.0	0.0175
07-07A-16	0.2277	0.0	590.0000	0.0	0.0	0.0147	0.0157	0.0	0.0157
07-07A-17	0.2113	0.0	593.0000	0.0	0.0	0.0137	0.0145	0.0	0.0145
07-07A-18	0.2049	0.0	588.0000	0.0	0.0	0.0132	0.0141	0.0	0.0141
07-07A-19	0.1909	0.0	584.0000	0.0	0.0	0.0123	0.0131	0.0	0.0131
07-07A-20	0.1748	0.0	590.0000	0.0	0.0	0.0112	0.0120	0.0	0.0120
07-07A-21	0.1646	0.0	586.0000	0.0	0.0	0.0114	0.0113	0.0	0.0113
07-07A-22	0.1811	0.0	595.0000	0.0	0.0	0.0125	0.0125	0.0	0.0125
07-07A-23	0.1731	0.0	583.0000	0.0	0.0	0.0120	0.0119	0.0	0.0119
07-07A-24	0.1661	0.0	586.0000	0.0	0.0	0.0113	0.0114	0.0	0.0114
07-07A-25	0.1580	0.0	583.0000	0.0	0.0	0.0110	0.0109	0.0	0.0109
07-07A-26	0.1516	0.0	583.0000	0.0	0.0	0.0105	0.0104	0.0	0.0104
07-07A-27	0.2980	0.0	772.0000	0.0	0.0	0.0198	0.0205	0.0	0.0205
07-07A-28	0.2833	0.0	776.0000	0.0	0.0	0.0188	0.0195	0.0	0.0195
07-07A-29	0.2588	0.0	771.0000	0.0	0.0	0.0171	0.0178	0.0	0.0178
07-07A-30	0.2372	0.0	765.0000	0.0	0.0	0.0155	0.0163	0.0	0.0163
07-07A-31	0.2134	0.0	766.0000	0.0	0.0	0.0139	0.0147	0.0	0.0147
07-07A-32	0.2046	0.0	775.0000	0.0	0.0	0.0132	0.0141	0.0	0.0141
07-07A-33	0.1934	0.0	778.0000	0.0	0.0	0.0125	0.0133	0.0	0.0133
07-07A-34	0.1832	0.0	771.0000	0.0	0.0	0.0118	0.0126	0.0	0.0126
07-07A-35	0.1727	0.0	769.0000	0.0	0.0	0.0111	0.0119	0.0	0.0119
07-07A-36	0.1680	0.0	772.0000	0.0	0.0	0.0108	0.0116	0.0	0.0116
07-07A-37	0.1586	0.0	775.0000	0.0	0.0	0.0101	0.0109	0.0	0.0109
07-07A-38	0.1459	0.0	776.0000	0.0	0.0	0.0092	0.0100	0.0	0.0100
07-07A-39	0.1779	0.0	781.0000	0.0	0.0	0.0120	0.0122	0.0	0.0122
07-07A-40	0.1649	0.0	778.0000	0.0	0.0	0.0111	0.0113	0.0	0.0113
07-07A-41	0.1523	0.0	779.0000	0.0	0.0	0.0101	0.0105	0.0	0.0105
07-07A-42	0.1473	0.0	779.0000	0.0	0.0	0.0099	0.0101	0.0	0.0101
07-07A-43	0.1424	0.0	775.0000	0.0	0.0	0.0094	0.0098	0.0	0.0098
07-07A-44	0.2344	0.0	780.0000	0.0	0.0	0.0151	0.0161	0.0	0.0161
07-07A-45	0.2125	0.0	762.0000	0.0	0.0	0.0136	0.0146	0.0	0.0146
07-07A-46	0.1964	0.0	770.0000	0.0	0.0	0.0124	0.0135	0.0	0.0135
07-07A-47	0.1334	0.0	774.0000	0.0	0.0	0.0000	0.0092	0.0	0.0092
11-01A-1	0.2828	577.0000	573.0000	778.0000	1166.0000	0.0216	0.0195	0.0195	0.0
11-01A-2	0.3855	574.0000	573.0000	862.0000	1245.0000	0.0288	0.0265	0.0265	0.0
11-01A-3	0.2497	0.0	0.0	0.0	0.0	0.0	0.0172	0.0172	0.0
11-02A-1	0.0	585.0000	566.0000	558.0000	561.0000	0.0	0.0	0.0	0.0
11-03A-1	0.0067	900.0000	786.0000	598.0000	587.0000	0.0004	0.0005	0.0005	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
11-04A-1	0.0187	1423.0000	691.0000	585.0000	576.0000	0.0008	0.0013	0.0013	0.0
11-05A-1	0.2132	1250.0000	900.0000	600.0000	600.0000	0.0	0.0147	0.0012	0.0134
11-06A-1	0.0	591.0000	560.0000	542.0000	513.0000	0.0	0.0	0.0	0.0
11-06A-2	0.3372	511.0000	549.0000	704.0000	431.0000	0.0	0.0232	0.0232	0.0
11-07A-1	0.0	65.0000	79.0000	80.0000	80.0000	0.0	0.0006	0.0006	0.0
11-07A-2	0.0	0.0	0.0	535.0000	298.0000	0.0	0.0009	0.0009	0.0
11-08A-1	0.1387	600.0000	643.0000	1218.0000	564.0000	0.1663	0.1363	0.1363	0.0
11-08A-2	0.1912	492.0000	557.0000	1441.0000	556.0000	0.2224	0.1907	0.1907	0.0
11-08A-3	0.2497	464.0000	549.0000	1481.0000	568.0000	0.2939	0.2491	0.2491	0.0
11-08A-4	0.3086	464.0000	517.0000	1405.0000	574.0000	0.3656	0.3079	0.3079	0.0
11-09A-1	0.0	582.0000	581.0000	572.0000	572.0000	0.0	0.0007	0.0007	0.0
11-09A-2	0.0	584.0000	582.0000	571.0000	0.0	0.0	0.0008	0.0008	0.0
11-10A-1	0.1578	639.0000	700.0000	826.0000	0.0	0.1619	0.1574	0.1574	0.0
11-10A-2	0.1235	645.0000	685.0000	766.0000	0.0	0.1266	0.1232	0.1232	0.0
11-10A-3	0.0926	643.0000	687.0000	733.0000	0.0	0.1006	0.0923	0.0923	0.0
11-11A-1	0.0262	997.0000	1265.0000	601.0000	579.0000	0.0012	0.0018	0.0018	0.0
11-12A-1	0.3461	600.0000	760.0000	680.0000	1226.0000	0.0233	0.0238	0.0013	0.0225
11-12A-2	0.3246	663.0000	771.0000	670.0000	1250.0000	0.0217	0.0223	0.0013	0.0211
11-12A-3	0.2969	665.0000	759.0000	665.0000	1252.0000	0.0195	0.0204	0.0012	0.0192
14-01A-1	0.1359	346.0000	143.0000	201.0000	660.0000	0.0	0.0079	0.0079	0.0
14-01A-2	0.1428	657.0000	470.0000	489.0000	994.0000	0.0	0.0083	0.0083	0.0
14-01A-3	0.1326	676.0000	593.0000	548.0000	1015.0000	0.0070	0.0077	0.0077	0.0
14-02A-1	0.3550	621.0000	592.0000	499.0000	1227.0000	0.0213	0.0206	0.0206	0.0
14-02A-2	0.2251	626.0000	593.0000	566.0000	1112.0000	0.0124	0.0131	0.0131	0.0
14-02A-3	0.2805	625.0000	595.0000	530.0000	1144.0000	0.0151	0.0163	0.0163	0.0
14-02A-4	0.3187	635.0000	599.0000	559.0000	1164.0000	0.0178	0.0185	0.0185	0.0
14-02A-5	0.3735	601.0000	577.0000	489.0000	1181.0000	0.0208	0.0217	0.0217	0.0
14-02A-6	0.3059	624.0000	589.0000	534.0000	1121.0000	0.0179	0.0178	0.0178	0.0
14-02A-7	0.2354	626.0000	589.0000	574.0000	1116.0000	0.0130	0.0137	0.0137	0.0
14-02A-8	0.3447	625.0000	585.0000	543.0000	1126.0000	0.0203	0.0200	0.0200	0.0
16-01A-1	0.2684	579.0000	664.0000	0.0	0.0	0.0158	0.0185	0.0185	0.0
16-01A-2	0.2486	572.0000	660.0000	0.0	0.0	0.0144	0.0171	0.0171	0.0
16-01A-3	0.2601	578.0000	663.0000	0.0	0.0	0.0152	0.0179	0.0179	0.0
16-01B-1	0.2483	580.0000	694.0000	0.0	0.0	0.0125	0.0171	0.0171	0.0
16-02A-1	0.2563	476.0000	657.0000	0.0	0.0	0.0188	0.0176	0.0176	0.0
16-02A-2	0.2360	496.0000	691.0000	0.0	0.0	0.0173	0.0162	0.0162	0.0
16-02A-3	0.2183	498.0000	693.0000	0.0	0.0	0.0158	0.0150	0.0150	0.0
16-03A-1	0.2629	546.0000	739.0000	0.0	0.0	0.0170	0.0181	0.0181	0.0
16-03A-2	0.2420	543.0000	723.0000	0.0	0.0	0.0156	0.0166	0.0166	0.0
16-03A-3	0.2171	736.0000	906.0000	0.0	0.0	0.0134	0.0149	0.0149	0.0
18-01A-1	0.1493	0.0	637.0000	642.0000	574.0000	0.0099	0.0103	0.0	0.0103
18-01A-2	0.2114	0.0	668.0000	706.0000	577.0000	0.0141	0.0145	0.0	0.0145
18-01A-3	0.2779	0.0	681.0000	740.0000	568.0000	0.0183	0.0191	0.0	0.0191
18-01A-4	0.3431	0.0	686.0000	757.0000	567.0000	0.0229	0.0236	0.0	0.0236
18-01A-5	0.3767	0.0	685.0000	749.0000	569.0000	0.0249	0.0259	0.0	0.0259
18-01A-6	0.1493	0.0	647.0000	651.0000	576.0000	0.0100	0.0103	0.0	0.0103
18-01A-7	0.2086	0.0	661.0000	706.0000	573.0000	0.0135	0.0144	0.0	0.0144
18-01A-8	0.3744	0.0	677.0000	756.0000	568.0000	0.0248	0.0258	0.0	0.0258
18-01A-9	0.2492	0.0	818.0000	858.0000	560.0000	0.0172	0.0171	0.0	0.0171
18-01A-10	0.3452	0.0	875.0000	947.0000	553.0000	0.0243	0.0238	0.0	0.0238
18-01A-11	0.3858	0.0	852.0000	921.0000	554.0000	0.0271	0.0265	0.0	0.0265

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
26-01A-1	0.0	586.0000	557.0000	551.0000	0.0	0.0	0.0	0.0	0.0
26-02A-1	0.3700	556.0000	548.0000	639.0000	0.0	0.0223	0.0255	0.0	0.0255
26-02A-2	0.3914	552.0000	549.0000	678.0000	0.0	0.0237	0.0269	0.0	0.0269
26-02A-3	0.4466	551.0000	547.0000	693.0000	0.0	0.0268	0.0307	0.0	0.0307
26-02A-4	0.4658	548.0000	543.0000	661.0000	0.0	0.0281	0.0320	0.0	0.0320
26-02A-5	0.4987	546.0000	543.0000	688.0000	0.0	0.0303	0.0343	0.0	0.0343
26-02A-6	0.4711	534.0000	560.0000	950.0000	0.0	0.0306	0.0324	0.0324	0.0
26-02A-7	0.4193	557.0000	538.0000	706.0000	0.0	0.0261	0.0289	0.0289	0.0
26-02A-8	0.3634	559.0000	539.0000	653.0000	0.0	0.0236	0.0250	0.0250	0.0
26-02A-9	0.4511	793.0000	895.0000	1498.0000	0.0	0.0267	0.0310	0.0	0.0310
26-02A-10	0.3921	808.0000	822.0000	1155.0000	0.0	0.0236	0.0270	0.0	0.0270
26-03A-1	0.3684	582.0000	623.0000	995.0000	0.0	0.0213	0.0236	0.0236	0.0
26-03A-2	0.2905	591.0000	691.0000	1409.0000	0.0	0.0154	0.0186	0.0186	0.0
26-03A-3	0.3382	592.0000	697.0000	1538.0000	0.0	0.0178	0.0216	0.0216	0.0
26-03A-4	0.3640	593.0000	713.0000	1628.0000	0.0	0.0199	0.0233	0.0233	0.0
26-03A-5	0.2700	592.0000	682.0000	1328.0000	0.0	0.0136	0.0173	0.0173	0.0
26-03A-6	0.3677	0.0	0.0	0.0	0.0	0.0262	0.0253	0.0	0.0253
26-03A-7	0.3351	0.0	0.0	0.0	0.0	0.0233	0.0231	0.0	0.0231
26-03A-8	0.2692	0.0	0.0	0.0	0.0	0.0193	0.0185	0.0	0.0185
26-03A-9	0.2864	0.0	0.0	0.0	0.0	0.0226	0.0197	0.0	0.0197
26-03A-10	0.4004	0.0	0.0	0.0	0.0	0.0240	0.0256	0.0256	0.0
28-01A-1	0.1385	933.0000	696.0000	628.0000	775.0000	0.0094	0.0095	0.0011	0.0084
28-01A-2	0.2315	911.0000	657.0000	605.0000	956.0000	0.0158	0.0159	0.0011	0.0148
28-01A-3	0.2776	903.0000	644.0000	563.0000	953.0000	0.0190	0.0191	0.0011	0.0180
28-01A-4	0.3254	908.0000	654.0000	565.0000	973.0000	0.0223	0.0224	0.0011	0.0213
28-01A-5	0.3726	924.0000	650.0000	553.0000	1024.0000	0.0258	0.0256	0.0011	0.0245
28-01A-6	0.4000	895.0000	634.0000	535.0000	1036.0000	0.0272	0.0275	0.0011	0.0264
28-01A-7	0.4347	914.0000	638.0000	539.0000	1076.0000	0.0302	0.0299	0.0011	0.0288
28-02A-1	0.1698	1325.0000	778.0000	619.0000	1317.0000	0.0116	0.0117	0.0012	0.0105
28-02A-2	0.2151	1286.0000	760.0000	619.0000	1476.0000	0.0153	0.0148	0.0012	0.0136
28-02A-3	0.2689	1261.0000	726.0000	615.0000	1452.0000	0.0189	0.0185	0.0012	0.0173
28-02A-4	0.3225	1247.0000	700.0000	613.0000	1592.0000	0.0227	0.0222	0.0012	0.0210
28-02A-5	0.3773	1244.0000	702.0000	617.0000	1685.0000	0.0264	0.0260	0.0014	0.0245
28-02A-6	0.4238	1282.0000	690.0000	607.0000	1730.0000	0.0293	0.0292	0.0014	0.0277
28-03A-1	0.1773	1281.0000	678.0000	640.0000	1628.0000	0.0120	0.0122	0.0009	0.0113
28-03A-2	0.2377	1290.0000	658.0000	647.0000	1816.0000	0.0163	0.0164	0.0009	0.0155
28-03A-3	0.2982	1286.0000	629.0000	656.0000	1701.0000	0.0201	0.0205	0.0008	0.0197
28-03A-4	0.3593	1298.0000	629.0000	677.0000	1459.0000	0.0245	0.0247	0.0009	0.0239
28-03A-5	0.4203	1291.0000	618.0000	672.0000	1433.0000	0.0285	0.0289	0.0009	0.0281
28-04A-1	0.0	589.0000	587.0000	570.0000	0.0	0.0	0.0	0.0	0.0
28-05A-1	0.1649	590.0000	607.0000	1197.0000	0.0	0.0075	0.0096	0.0096	0.0
28-05A-2	0.2177	588.0000	599.0000	1313.0000	0.0	0.0108	0.0126	0.0126	0.0
28-05A-3	0.2766	592.0000	606.0000	1469.0000	0.0	0.0142	0.0161	0.0161	0.0
28-05A-4	0.3334	583.0000	600.0000	1471.0000	0.0	0.0173	0.0194	0.0194	0.0
28-05A-5	0.3978	582.0000	599.0000	1415.0000	0.0	0.0215	0.0231	0.0231	0.0
28-05A-6	0.1566	596.0000	609.0000	1172.0000	0.0	0.0078	0.0091	0.0091	0.0
28-05A-7	0.1998	593.0000	608.0000	1252.0000	0.0	0.0088	0.0116	0.0116	0.0
28-05A-8	0.2573	595.0000	613.0000	1413.0000	0.0	0.0133	0.0149	0.0149	0.0
28-05A-9	0.3159	593.0000	616.0000	1500.0000	0.0	0.0167	0.0184	0.0184	0.0
28-05A-10	0.3734	587.0000	618.0000	1440.0000	0.0	0.0207	0.0217	0.0217	0.0
28-05A-11	0.4327	579.0000	616.0000	1398.0000	0.0	0.0238	0.0251	0.0251	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
917	28-05A-12	0.4619	574.0000	615.0000	1374.0000	0.0	0.0260	0.0268	0.0268	0.0
918	28-05A-13	0.4915	572.0000	617.0000	1347.0000	0.0	0.0280	0.0286	0.0286	0.0
919	28-05A-14	0.2002	587.0000	610.0000	1227.0000	0.0	0.0089	0.0116	0.0116	0.0
921	28-06A-1	0.1523	582.0000	615.0000	1245.0000	0.0	0.0079	0.0089	0.0089	0.0
922	28-06A-2	0.1927	590.0000	614.0000	1338.0000	0.0	0.0101	0.0112	0.0112	0.0
923	28-06A-3	0.2480	592.0000	620.0000	1408.0000	0.0	0.0130	0.0144	0.0144	0.0
924	28-06A-4	0.3039	592.0000	623.0000	1465.0000	0.0	0.0159	0.0177	0.0177	0.0
925	28-06A-5	0.3579	588.0000	627.0000	1455.0000	0.0	0.0183	0.0208	0.0208	0.0
926	28-06A-6	0.4131	571.0000	615.0000	1440.0000	0.0	0.0219	0.0240	0.0240	0.0
927	28-06A-7	0.4484	567.0000	617.0000	1418.0000	0.0	0.0241	0.0261	0.0261	0.0
928	28-06A-8	0.3065	595.0000	629.0000	1439.0000	0.0	0.0158	0.0178	0.0178	0.0
930	28-07A-1	0.1518	596.0000	606.0000	1361.0000	0.0	0.0083	0.0088	0.0088	0.0
931	28-07A-2	0.1965	584.0000	599.0000	1387.0000	0.0	0.0098	0.0114	0.0114	0.0
932	28-07A-3	0.2524	590.0000	606.0000	1601.0000	0.0	0.0134	0.0147	0.0147	0.0
933	28-07A-4	0.3091	586.0000	613.0000	1705.0000	0.0	0.0170	0.0180	0.0180	0.0
934	28-07A-5	0.3655	581.0000	613.0000	1691.0000	0.0	0.0195	0.0212	0.0212	0.0
935	28-07A-6	0.4214	569.0000	605.0000	1630.0000	0.0	0.0233	0.0245	0.0245	0.0
936	28-07A-7	0.4465	561.0000	601.0000	1618.0000	0.0	0.0255	0.0259	0.0259	0.0
937	28-07A-8	0.4347	564.0000	602.0000	1622.0000	0.0	0.0241	0.0253	0.0253	0.0
938	28-07A-9	0.1980	587.0000	604.0000	1396.0000	0.0	0.0102	0.0115	0.0115	0.0
956	29-01A-1	0.3242	441.0000	1117.0000	1078.0000	592.0000	0.0212	0.0223	0.0223	0.0
957	29-01A-2	0.4038	434.0000	951.0000	1047.0000	604.0000	0.0267	0.0278	0.0278	0.0
958	29-01A-3	0.2448	460.0000	1290.0000	1204.0000	587.0000	0.0158	0.0168	0.0168	0.0
959	29-01A-4	0.1832	495.0000	1423.0000	1360.0000	589.0000	0.0118	0.0126	0.0126	0.0
961	29-02A-1	0.2490	478.0000	1372.0000	1111.0000	0.0	0.0167	0.0171	0.0171	0.0
962	29-02A-2	0.1879	503.0000	1298.0000	1585.0000	0.0	0.0123	0.0129	0.0129	0.0
963	29-02A-3	0.1482	522.0000	1383.0000	1560.0000	0.0	0.0099	0.0102	0.0102	0.0
964	29-02A-4	0.1055	571.0000	1622.0000	1513.0000	0.0	0.0074	0.0073	0.0073	0.0
965	29-02A-5	0.0779	595.0000	1637.0000	1363.0000	0.0	0.0060	0.0054	0.0054	0.0
966	29-02A-6	0.3040	481.0000	1377.0000	1014.0000	0.0	0.0206	0.0209	0.0209	0.0
967	29-02A-7	0.3616	464.0000	1226.0000	885.0000	0.0	0.0244	0.0249	0.0249	0.0
970	29-02A-8	0.2491	479.0000	1422.0000	963.0000	0.0	0.0164	0.0171	0.0171	0.0
971	29-02A-9	0.3081	468.0000	1277.0000	875.0000	0.0	0.0205	0.0212	0.0212	0.0
972	29-02A-10	0.1893	501.0000	1362.0000	1239.0000	0.0	0.0119	0.0130	0.0130	0.0
973	29-02A-11	0.1266	527.0000	1499.0000	1353.0000	0.0	0.0088	0.0087	0.0087	0.0
974	29-02A-12	0.0778	578.0000	1595.0000	1100.0000	0.0	0.0059	0.0054	0.0054	0.0
975	29-02A-13	0.0544	606.0000	1390.0000	932.0000	0.0	0.0040	0.0037	0.0037	0.0
976	29-02A-14	0.1303	527.0000	1587.0000	1308.0000	0.0	0.0092	0.0090	0.0090	0.0
978	29-03A-1	0.2104	433.0000	1191.0000	1007.0000	0.0	0.0146	0.0145	0.0145	0.0
979	29-03A-2	0.2686	414.0000	999.0000	850.0000	0.0	0.0192	0.0185	0.0185	0.0
980	29-03A-3	0.3079	406.0000	985.0000	755.0000	0.0	0.0220	0.0212	0.0212	0.0
981	29-03A-4	0.3465	406.0000	938.0000	733.0000	0.0	0.0248	0.0238	0.0238	0.0
982	29-03A-5	0.0855	501.0000	1724.0000	1335.0000	0.0	0.0074	0.0059	0.0059	0.0
983	29-03A-6	0.1270	478.0000	1498.0000	1255.0000	0.0	0.0099	0.0087	0.0087	0.0
984	29-03A-7	0.1712	460.0000	1330.0000	1276.0000	0.0	0.0125	0.0118	0.0118	0.0
985	29-03A-8	0.0538	590.0000	1606.0000	1166.0000	0.0	0.0046	0.0037	0.0037	0.0
986	29-03A-9	0.1895	448.0000	1400.0000	1232.0000	0.0	0.0135	0.0130	0.0130	0.0
988	29-03A-10	0.1913	413.0000	945.0000	1062.0000	0.0	0.0124	0.0132	0.0132	0.0
989	29-03A-11	0.2286	404.0000	868.0000	966.0000	0.0	0.0152	0.0157	0.0157	0.0
990	29-03A-12	0.2656	394.0000	824.0000	817.0000	0.0	0.0180	0.0183	0.0183	0.0
991	29-03A-13	0.3057	387.0000	799.0000	762.0000	0.0	0.0208	0.0210	0.0210	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-03A-14	0.3474	387.0000	773.0000	731.0000	0.0	0.0237	0.0239	0.0239	0.0
29-03A-15	0.1397	426.0000	951.0000	848.0000	0.0	0.0093	0.0096	0.0096	0.0
29-03A-16	0.1067	448.0000	953.0000	791.0000	0.0	0.0079	0.0073	0.0073	0.0
29-03A-17	0.0790	476.0000	958.0000	912.0000	0.0	0.0063	0.0054	0.0054	0.0
29-03A-18	0.0551	505.0000	1090.0000	1002.0000	0.0	0.0045	0.0038	0.0038	0.0
29-04A-1	0.0911	599.0000	1171.0000	1287.0000	587.0000	0.0065	0.0063	0.0	0.0063
29-04A-2	0.1265	587.0000	1261.0000	1422.0000	601.0000	0.0084	0.0087	0.0	0.0087
29-04A-3	0.1635	569.0000	1400.0000	1574.0000	621.0000	0.0110	0.0112	0.0	0.0112
29-04A-4	0.1269	578.0000	1424.0000	1526.0000	601.0000	0.0089	0.0087	0.0087	0.0
29-04A-5	0.1729	560.0000	1441.0000	1542.0000	628.0000	0.0120	0.0119	0.0119	0.0
29-04A-6	0.2098	535.0000	1383.0000	1503.0000	643.0000	0.0145	0.0144	0.0144	0.0
29-04A-7	0.2475	504.0000	1302.0000	1481.0000	660.0000	0.0171	0.0170	0.0170	0.0
29-04A-8	0.2873	488.0000	1231.0000	1417.0000	675.0000	0.0200	0.0198	0.0198	0.0
29-04A-9	0.3220	476.0000	1155.0000	1264.0000	671.0000	0.0223	0.0222	0.0222	0.0
29-05A-1	0.0868	599.0000	1203.0000	1280.0000	0.0	0.0064	0.0060	0.0060	0.0
29-05A-2	0.1289	596.0000	1591.0000	1463.0000	0.0	0.0091	0.0089	0.0089	0.0
29-05A-3	0.1735	592.0000	1741.0000	1671.0000	0.0	0.0119	0.0119	0.0119	0.0
29-05A-4	0.2108	559.0000	1640.0000	1621.0000	0.0	0.0148	0.0145	0.0145	0.0
29-05A-5	0.2483	535.0000	1503.0000	1566.0000	0.0	0.0174	0.0171	0.0171	0.0
29-05A-6	0.2861	517.0000	1150.0000	1587.0000	0.0	0.0204	0.0197	0.0197	0.0
29-05A-7	0.3244	506.0000	1091.0000	1531.0000	0.0	0.0232	0.0223	0.0223	0.0
29-05A-8	0.3647	498.0000	1365.0000	1375.0000	0.0	0.0258	0.0251	0.0251	0.0
29-05A-9	0.2258	532.0000	1214.0000	1574.0000	0.0	0.0158	0.0155	0.0155	0.0
29-06A-1	0.1265	595.0000	1618.0000	1484.0000	0.0	0.0087	0.0087	0.0087	0.0
29-06A-2	0.1706	594.0000	1891.0000	1609.0000	0.0	0.0111	0.0117	0.0117	0.0
29-06A-3	0.2076	593.0000	1901.0000	1566.0000	0.0	0.0137	0.0143	0.0143	0.0
29-06A-4	0.2442	568.0000	1645.0000	1488.0000	0.0	0.0165	0.0168	0.0168	0.0
29-06A-5	0.2825	558.0000	1512.0000	1452.0000	0.0	0.0190	0.0194	0.0194	0.0
29-06A-6	0.3216	547.0000	1226.0000	1384.0000	0.0	0.0219	0.0221	0.0221	0.0
29-06A-7	0.1297	606.0000	1825.0000	1509.0000	0.0	0.0090	0.0089	0.0089	0.0
29-06A-8	0.1749	603.0000	1905.0000	1593.0000	0.0	0.0114	0.0120	0.0120	0.0
29-06A-9	0.2123	587.0000	1815.0000	1541.0000	0.0	0.0140	0.0146	0.0146	0.0
29-06A-10	0.2497	571.0000	1678.0000	1464.0000	0.0	0.0166	0.0172	0.0172	0.0
29-06A-11	0.2889	562.0000	1559.0000	1414.0000	0.0	0.0193	0.0199	0.0199	0.0
29-06A-12	0.3261	554.0000	1575.0000	1303.0000	0.0	0.0217	0.0224	0.0224	0.0
29-06A-13	0.3663	538.0000	1433.0000	1155.0000	0.0	0.0243	0.0252	0.0252	0.0
29-06A-14	0.2285	564.0000	1716.0000	1388.0000	0.0	0.0153	0.0157	0.0157	0.0
29-06A-15	0.1917	587.0000	1823.0000	1503.0000	0.0	0.0130	0.0132	0.0132	0.0
29-06A-16	0.2388	568.0000	1634.0000	1403.0000	0.0	0.0160	0.0164	0.0164	0.0
29-06A-17	0.1071	612.0000	1768.0000	1474.0000	0.0	0.0079	0.0074	0.0074	0.0
29-06A-18	0.2473	563.0000	1578.0000	1411.0000	0.0	0.0165	0.0170	0.0170	0.0
29-07A-1	0.1767	881.0000	1403.0000	1730.0000	0.0	0.0112	0.0122	0.0122	0.0
29-07A-2	0.2144	934.0000	1500.0000	1781.0000	0.0	0.0137	0.0147	0.0147	0.0
29-07A-3	0.2484	975.0000	1526.0000	1788.0000	0.0	0.0160	0.0171	0.0171	0.0
29-07A-4	0.2902	998.0000	1492.0000	1737.0000	0.0	0.0190	0.0200	0.0200	0.0
29-07A-5	0.3488	981.0000	1412.0000	1550.0000	0.0	0.0233	0.0240	0.0240	0.0
29-08A-1	0.1729	585.0000	1841.0000	1861.0000	0.0	0.0111	0.0119	0.0119	0.0
29-08A-2	0.2096	562.0000	1744.0000	1789.0000	0.0	0.0134	0.0144	0.0144	0.0
29-08A-3	0.2484	553.0000	1583.0000	1749.0000	0.0	0.0159	0.0171	0.0171	0.0
29-08A-4	0.2862	539.0000	1393.0000	1584.0000	0.0	0.0185	0.0197	0.0197	0.0
29-08A-5	0.3297	538.0000	1306.0000	1401.0000	0.0	0.0210	0.0227	0.0227	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FADX1	FADX2
29-08A-6	0.2290	531.0000	1449.0000	1680.0000	0.0	0.0149	0.0158	0.0158	0.0
29-08A-7	0.1270	575.0000	1845.0000	1878.0000	0.0	0.0091	0.0087	0.0087	0.0
29-08A-8	0.0869	587.0000	1586.0000	1689.0000	0.0	0.0063	0.0060	0.0060	0.0
29-09A-1	0.1715	472.0000	1677.0000	1726.0000	0.0	0.0113	0.0118	0.0	0.0118
29-09A-2	0.2105	451.0000	1580.0000	1731.0000	0.0	0.0142	0.0145	0.0	0.0145
29-09A-3	0.2489	440.0000	1478.0000	1651.0000	0.0	0.0169	0.0171	0.0	0.0171
29-09A-4	0.2877	425.0000	1377.0000	1492.0000	0.0	0.0199	0.0198	0.0	0.0198
29-09A-5	0.3270	410.0000	1262.0000	1342.0000	0.0	0.0224	0.0225	0.0	0.0225
29-09A-6	0.1704	547.0000	1708.0000	1845.0000	0.0	0.0110	0.0117	0.0	0.0117
29-09A-7	0.1988	540.0000	1828.0000	1949.0000	0.0	0.0136	0.0137	0.0	0.0137
29-09A-8	0.2553	521.0000	1779.0000	1873.0000	0.0	0.0163	0.0176	0.0	0.0176
29-09A-9	0.2795	499.0000	1681.0000	1789.0000	0.0	0.0188	0.0192	0.0	0.0192
29-09A-10	0.3172	478.0000	1632.0000	1677.0000	0.0	0.0215	0.0218	0.0	0.0218
29-09A-11	0.3550	465.0000	1546.0000	1669.0000	0.0	0.0240	0.0244	0.0	0.0244
29-09A-12	0.2520	518.0000	1776.0000	1770.0000	0.0	0.0164	0.0173	0.0173	0.0
29-09A-13	0.2912	498.0000	1669.0000	1693.0000	0.0	0.0192	0.0200	0.0200	0.0
29-09A-14	0.3321	483.0000	1607.0000	1692.0000	0.0	0.0220	0.0228	0.0228	0.0
29-09A-15	0.3722	471.0000	1579.0000	1663.0000	0.0	0.0246	0.0256	0.0256	0.0
29-09A-16	0.2196	535.0000	1813.0000	1914.0000	0.0	0.0143	0.0151	0.0151	0.0
29-09A-17	0.1877	560.0000	1773.0000	1928.0000	0.0	0.0120	0.0129	0.0129	0.0
29-09A-18	0.1385	570.0000	1575.0000	1686.0000	0.0	0.0089	0.0095	0.0095	0.0
29-09A-19	0.1041	579.0000	1372.0000	1470.0000	0.0	0.0067	0.0072	0.0072	0.0
29-09A-20	0.2052	579.0000	1784.0000	1941.0000	0.0	0.0134	0.0141	0.0141	0.0
29-09A-21	0.2802	544.0000	1783.0000	1884.0000	0.0	0.0185	0.0193	0.0193	0.0
29-09A-22	0.3197	527.0000	1733.0000	1815.0000	0.0	0.0214	0.0220	0.0220	0.0
29-09A-23	0.3586	508.0000	1636.0000	1747.0000	0.0	0.0239	0.0247	0.0247	0.0
29-09A-24	0.2995	531.0000	1728.0000	1816.0000	0.0	0.0202	0.0206	0.0206	0.0
29-10A-1	0.1477	0.0	580.0000	1693.0000	1654.0000	0.0101	0.0102	0.0	0.0102
29-10A-2	0.1814	0.0	567.0000	1616.0000	1694.0000	0.0120	0.0125	0.0	0.0125
29-10A-3	0.2154	0.0	559.0000	1523.0000	1657.0000	0.0146	0.0148	0.0	0.0148
29-10A-4	0.2490	0.0	544.0000	1422.0000	1446.0000	0.0168	0.0171	0.0	0.0171
29-10A-5	0.2826	0.0	533.0000	1283.0000	1231.0000	0.0190	0.0194	0.0	0.0194
29-10A-6	0.1673	0.0	564.0000	1700.0000	1730.0000	0.0111	0.0115	0.0	0.0115
29-10A-7	0.2042	0.0	559.0000	1689.0000	1771.0000	0.0135	0.0140	0.0	0.0140
29-10A-8	0.2374	0.0	551.0000	1623.0000	1609.0000	0.0164	0.0163	0.0	0.0163
29-10A-9	0.2733	0.0	538.0000	1523.0000	1384.0000	0.0184	0.0188	0.0	0.0188
29-10A-10	0.3197	0.0	518.0000	1373.0000	1199.0000	0.0217	0.0220	0.0	0.0220
29-10A-11	0.2578	0.0	619.0000	1661.0000	1479.0000	0.0171	0.0177	0.0	0.0177
29-10A-12	0.2923	0.0	612.0000	1367.0000	1368.0000	0.0198	0.0201	0.0	0.0201
29-10A-13	0.3339	0.0	599.0000	1399.0000	1229.0000	0.0225	0.0230	0.0	0.0230
29-10A-14	0.2065	0.0	632.0000	1750.0000	1602.0000	0.0140	0.0142	0.0	0.0142
29-10A-15	0.1716	0.0	666.0000	1775.0000	1734.0000	0.0117	0.0118	0.0	0.0118
29-10A-16	0.2352	0.0	681.0000	1882.0000	1798.0000	0.0158	0.0162	0.0	0.0162
29-10A-17	0.2682	0.0	639.0000	1801.0000	1739.0000	0.0185	0.0185	0.0	0.0185
29-10A-18	0.3090	0.0	624.0000	1739.0000	1720.0000	0.0213	0.0213	0.0	0.0213
29-10A-19	0.1905	0.0	688.0000	1966.0000	1887.0000	0.0131	0.0131	0.0	0.0131
29-10A-20	0.2508	0.0	666.0000	1844.0000	1771.0000	0.0165	0.0173	0.0173	0.0
29-10A-21	0.2957	0.0	645.0000	1745.0000	1691.0000	0.0195	0.0203	0.0203	0.0
29-10A-22	0.3393	0.0	622.0000	1673.0000	1648.0000	0.0223	0.0233	0.0233	0.0
29-10A-23	0.2337	0.0	667.0000	1888.0000	1805.0000	0.0153	0.0161	0.0161	0.0
29-10A-24	0.2123	0.0	709.0000	1957.0000	1866.0000	0.0138	0.0146	0.0146	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EGR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
1105	29-10A-25	0.1269	0.0	631.0000	1614.0000	1746.0000	0.0084	0.0087	0.0087	0.0
1106	29-10A-26	0.1496	0.0	644.0000	1778.0000	1897.0000	0.0100	0.0103	0.0103	0.0
1107	29-10A-27	0.2025	0.0	661.0000	1896.0000	1876.0000	0.0135	0.0139	0.0139	0.0
1108	29-10A-28	0.2113	0.0	655.0000	1703.0000	1736.0000	0.0141	0.0145	0.0145	0.0
1109	29-10A-29	0.2430	0.0	688.0000	1766.0000	1950.0000	0.0162	0.0167	0.0167	0.0
1110	29-10A-30	0.2504	0.0	694.0000	1752.0000	1979.0000	0.0166	0.0172	0.0172	0.0
1111	29-11A-1	0.0	0.0	549.0000	556.0000	547.0000	0.0	0.0	0.0	0.0
1113	29-11B-1	0.3567	0.0	565.0000	1733.0000	1759.0000	0.0245	0.0245	0.0	0.0245
1114	29-11B-2	0.3639	0.0	561.0000	1872.0000	1918.0000	0.0255	0.0250	0.0	0.0250
1116	29-12A-1	0.2685	0.0	0.0	1067.0000	1871.0000	0.0188	0.0185	0.0	0.0185
1117	29-12A-2	0.2847	0.0	0.0	969.0000	1513.0000	0.0189	0.0196	0.0	0.0196
1118	29-12A-3	0.3018	0.0	0.0	1295.0000	1552.0000	0.0213	0.0208	0.0	0.0208
1119	29-12A-4	0.3246	0.0	0.0	1157.0000	1420.0000	0.0229	0.0223	0.0	0.0223
1120	29-12A-5	0.2578	0.0	0.0	1343.0000	1899.0000	0.0178	0.0177	0.0	0.0177
1121	29-12A-6	0.3015	0.0	0.0	1256.0000	1792.0000	0.0201	0.0207	0.0207	0.0
1122	29-12A-7	0.2830	0.0	0.0	1346.0000	1860.0000	0.0188	0.0195	0.0195	0.0
1123	29-12A-8	0.2683	0.0	0.0	1376.0000	1907.0000	0.0179	0.0185	0.0185	0.0
1124	29-12A-9	0.2527	0.0	0.0	1437.0000	1955.0000	0.0168	0.0174	0.0174	0.0
1125	29-12A-10	0.3478	0.0	0.0	1420.0000	1912.0000	0.0232	0.0239	0.0239	0.0
1127	29-13A-1	0.1687	0.0	0.0	710.0000	1126.0000	0.0098	0.0116	0.0	0.0116
1128	29-13A-2	0.2073	0.0	0.0	670.0000	1250.0000	0.0125	0.0143	0.0	0.0143
1129	29-13A-3	0.2946	0.0	0.0	632.0000	1205.0000	0.0188	0.0203	0.0	0.0203
1131	29-13B-1	0.2452	0.0	0.0	603.0000	1022.0000	0.0153	0.0169	0.0	0.0169
1132	29-13B-2	0.2117	0.0	0.0	620.0000	1133.0000	0.0131	0.0146	0.0	0.0146
1133	29-13B-3	0.1708	0.0	0.0	651.0000	1408.0000	0.0108	0.0118	0.0	0.0118
1134	29-13B-4	0.1275	0.0	0.0	648.0000	1725.0000	0.0084	0.0088	0.0	0.0088
1135	29-13B-5	0.1009	0.0	0.0	701.0000	1705.0000	0.0061	0.0069	0.0	0.0069
1136	29-13B-6	0.1754	0.0	0.0	607.0000	1119.0000	0.0104	0.0121	0.0121	0.0
1137	29-13B-7	0.0894	0.0	0.0	678.0000	1553.0000	0.0059	0.0061	0.0061	0.0
1138	29-13B-8	0.1295	0.0	0.0	638.0000	1709.0000	0.0082	0.0089	0.0089	0.0
1139	29-13B-9	0.2188	0.0	0.0	608.0000	1065.0000	0.0133	0.0151	0.0151	0.0
1140	29-13B-10	0.2597	0.0	0.0	608.0000	898.0000	0.0155	0.0179	0.0179	0.0
1142	29-14A-1	0.2305	0.0	0.0	612.0000	1279.0000	0.0149	0.0159	0.0	0.0159
1143	29-14A-2	0.1861	0.0	0.0	603.0000	1527.0000	0.0120	0.0128	0.0	0.0128
1144	29-14A-3	0.1647	0.0	0.0	605.0000	1604.0000	0.0108	0.0113	0.0	0.0113
1145	29-14A-4	0.1271	0.0	0.0	626.0000	1537.0000	0.0085	0.0087	0.0	0.0087
1146	29-14A-5	0.2579	0.0	0.0	572.0000	1288.0000	0.0166	0.0177	0.0	0.0177
1147	29-14A-6	0.1436	0.0	0.0	616.0000	1576.0000	0.0090	0.0099	0.0099	0.0
1148	29-14A-7	0.1735	0.0	0.0	619.0000	1717.0000	0.0109	0.0119	0.0119	0.0
1149	29-14A-8	0.2124	0.0	0.0	593.0000	1682.0000	0.0132	0.0146	0.0146	0.0
1150	29-14A-9	0.2552	0.0	0.0	580.0000	1119.0000	0.0160	0.0176	0.0176	0.0
1151	29-14A-10	0.1822	0.0	0.0	649.0000	1684.0000	0.0113	0.0125	0.0125	0.0
1152	29-14A-11	0.2138	0.0	0.0	600.0000	1708.0000	0.0137	0.0147	0.0147	0.0
1153	29-14A-12	0.2526	0.0	0.0	578.0000	1469.0000	0.0161	0.0174	0.0174	0.0
1155	29-15A-1	0.1647	0.0	0.0	620.0000	1638.0000	0.0109	0.0113	0.0	0.0113
1156	29-15A-2	0.2027	0.0	0.0	621.0000	1662.0000	0.0137	0.0139	0.0	0.0139
1157	29-15A-3	0.2396	0.0	0.0	604.0000	1610.0000	0.0163	0.0165	0.0	0.0165
1158	29-15A-4	0.2764	0.0	0.0	591.0000	1440.0000	0.0188	0.0190	0.0	0.0190
1159	29-15A-5	0.3142	0.0	0.0	579.0000	1222.0000	0.0214	0.0216	0.0	0.0216
1160	29-15A-6	0.2109	0.0	0.0	613.0000	1635.0000	0.0142	0.0145	0.0145	0.0
1161	29-15A-7	0.2500	0.0	0.0	597.0000	1649.0000	0.0168	0.0172	0.0172	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAQX1	FAQ[illegible]
29-15A-8	0.1924	0.0	0.0	615.0000	1615.0000	0.0127	0.0132	0.0132	0.0
29-15A-9	0.2898	0.0	0.0	591.0000	1383.0000	0.0194	0.0199	0.0199	0.0
29-15A-10	0.1811	0.0	0.0	622.0000	1640.0000	0.0117	0.0125	0.0125	0.0
29-15A-11	0.1792	0.0	0.0	618.0000	1685.0000	0.0115	0.0123	0.0123	0.0
29-15A-12	0.2166	0.0	0.0	603.0000	1294.0000	0.0142	0.0149	0.0149	0.0
29-15A-13	0.2558	0.0	0.0	598.0000	1023.0000	0.0169	0.0176	0.0176	0.0
29-15A-14	0.1461	0.0	0.0	682.0000	1164.0000	0.0095	0.0101	0.0101	0.0
29-15A-15	0.1450	0.0	0.0	624.0000	1695.0000	0.0094	0.0100	0.0100	0.0
29-15A-16	0.1365	0.0	0.0	619.0000	1624.0000	0.0089	0.0094	0.0094	0.0
29-15A-17	0.1779	0.0	0.0	607.0000	1684.0000	0.0114	0.0122	0.0122	0.0
29-15A-18	0.2111	0.0	0.0	601.0000	1661.0000	0.0138	0.0145	0.0145	0.0
29-15A-19	0.2495	0.0	0.0	586.0000	1358.0000	0.0165	0.0172	0.0172	0.0
29-16A-1	0.2331	0.0	0.0	587.0000	1417.0000	0.0160	0.0160	0.0	0.0160
29-16A-2	0.2762	0.0	0.0	562.0000	1365.0000	0.0193	0.0190	0.0	0.0190
29-16A-3	0.3163	0.0	0.0	569.0000	1154.0000	0.0222	0.0218	0.0	0.0218
29-16A-4	0.1426	0.0	0.0	608.0000	1390.0000	0.0099	0.0098	0.0	0.0098
29-16A-5	0.2067	0.0	0.0	604.0000	1286.0000	0.0135	0.0142	0.0142	0.0
29-16A-6	0.2487	0.0	0.0	596.0000	1441.0000	0.0166	0.0171	0.0171	0.0
29-16A-7	0.2959	0.0	0.0	580.0000	1329.0000	0.0199	0.0204	0.0204	0.0
29-16A-8	0.2055	0.0	0.0	603.0000	1447.0000	0.0134	0.0141	0.0141	0.0
29-16A-9	0.1540	0.0	0.0	634.0000	1554.0000	0.0102	0.0106	0.0106	0.0
29-16A-10	0.1593	0.0	0.0	610.0000	1473.0000	0.0105	0.0110	0.0110	0.0
29-16A-11	0.1934	0.0	0.0	611.0000	1502.0000	0.0132	0.0133	0.0	0.0133
29-17A-1	0.2131	0.0	809.0000	0.0	1643.0000	0.0137	0.0147	0.0	0.0147
29-17A-2	0.2523	0.0	759.0000	0.0	1683.0000	0.0162	0.0174	0.0	0.0174
29-17A-3	0.2913	0.0	729.0000	0.0	1677.0000	0.0187	0.0200	0.0	0.0200
29-17A-4	0.3208	0.0	701.0000	0.0	1593.0000	0.0215	0.0221	0.0	0.0221
29-17A-5	0.2209	0.0	756.0000	0.0	1629.0000	0.0138	0.0152	0.0152	0.0
29-17A-6	0.2574	0.0	743.0000	0.0	1657.0000	0.0162	0.0177	0.0177	0.0
29-17A-7	0.2368	0.0	732.0000	0.0	1583.0000	0.0148	0.0163	0.0163	0.0
29-17A-8	0.1785	0.0	744.0000	0.0	1582.0000	0.0114	0.0123	0.0123	0.0
29-17A-9	0.1322	0.0	703.0000	0.0	1561.0000	0.0086	0.0091	0.0091	0.0
29-17A-10	0.1277	0.0	722.0000	0.0	1564.0000	0.0085	0.0088	0.0088	0.0
29-17A-11	0.1071	0.0	805.0000	0.0	1565.0000	0.0065	0.0074	0.0074	0.0
29-18A-1	0.2107	0.0	662.0000	1615.0000	1522.0000	0.0134	0.0145	0.0145	0.0
29-18A-2	0.2621	0.0	651.0000	1622.0000	1572.0000	0.0170	0.0180	0.0180	0.0
29-18A-3	0.2714	0.0	638.0000	1622.0000	1583.0000	0.0176	0.0187	0.0187	0.0
29-18A-4	0.2905	0.0	615.0000	1600.0000	1557.0000	0.0188	0.0200	0.0200	0.0
29-18A-5	0.2641	0.0	676.0000	1567.0000	1524.0000	0.0171	0.0182	0.0182	0.0
29-18A-6	0.2311	0.0	740.0000	1610.0000	1553.0000	0.0148	0.0159	0.0159	0.0
29-18A-7	0.1943	0.0	704.0000	1596.0000	1496.0000	0.0122	0.0134	0.0134	0.0
29-18A-8	0.1948	0.0	733.0000	1566.0000	1486.0000	0.0123	0.0134	0.0134	0.0
29-18A-9	0.1937	0.0	700.0000	1550.0000	1459.0000	0.0122	0.0133	0.0133	0.0
29-18A-10	0.1931	0.0	663.0000	1531.0000	1434.0000	0.0122	0.0133	0.0133	0.0
29-18A-11	0.1264	0.0	815.0000	1454.0000	1401.0000	0.0080	0.0087	0.0087	0.0
29-18A-12	0.1249	0.0	677.0000	1419.0000	1324.0000	0.0079	0.0086	0.0086	0.0
29-18A-13	0.1250	0.0	709.0000	1472.0000	1330.0000	0.0079	0.0086	0.0086	0.0
29-18A-14	0.1227	0.0	639.0000	1338.0000	1260.0000	0.0078	0.0084	0.0084	0.0
29-18A-15	0.1935	0.0	673.0000	1524.0000	1465.0000	0.0122	0.0133	0.0133	0.0
29-18A-16	0.2362	0.0	723.0000	1578.0000	1532.0000	0.0152	0.0162	0.0162	0.0
29-18A-17	0.2357	0.0	719.0000	1565.0000	1536.0000	0.0151	0.0162	0.0162	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-18A-18	0.2359	0.0	718.0000	1371.0000	1541.0000	0.0151	0.0162	0.0162	0.0
29-19A-1	0.2052	0.0	724.0000	1487.0000	1674.0000	0.0142	0.0141	0.0141	0.0
29-19A-2	0.2054	0.0	730.0000	1483.0000	1648.0000	0.0138	0.0141	0.0141	0.0
29-19A-3	0.2073	0.0	687.0000	1440.0000	1605.0000	0.0141	0.0143	0.0143	0.0
29-19A-4	0.2067	0.0	674.0000	1365.0000	1530.0000	0.0140	0.0142	0.0142	0.0
29-19A-5	0.2498	0.0	747.0000	1446.0000	1626.0000	0.0171	0.0172	0.0172	0.0
29-19A-6	0.1732	0.0	749.0000	1467.0000	1644.0000	0.0121	0.0119	0.0119	0.0
29-19A-7	0.1756	0.0	650.0000	1349.0000	1521.0000	0.0121	0.0121	0.0121	0.0
29-19A-8	0.1302	0.0	724.0000	1338.0000	1504.0000	0.0095	0.0090	0.0090	0.0
29-19A-9	0.1741	0.0	717.0000	1393.0000	1686.0000	0.0114	0.0120	0.0120	0.0
29-19A-10	0.1743	0.0	604.0000	1376.0000	1666.0000	0.0116	0.0120	0.0120	0.0
29-19A-11	0.1744	0.0	677.0000	1385.0000	1665.0000	0.0116	0.0120	0.0120	0.0
29-19A-12	0.1741	0.0	642.0000	1377.0000	1661.0000	0.0118	0.0120	0.0120	0.0
29-19A-13	0.2080	0.0	766.0000	1484.0000	1842.0000	0.0142	0.0143	0.0143	0.0
29-19A-14	0.2099	0.0	595.0000	1379.0000	1720.0000	0.0145	0.0144	0.0144	0.0
29-19A-15	0.2491	0.0	669.0000	1459.0000	1823.0000	0.0172	0.0171	0.0171	0.0
29-19A-16	0.0864	0.0	647.0000	1203.0000	1470.0000	0.0067	0.0059	0.0059	0.0
29-19A-17	0.0905	0.0	829.0000	1328.0000	1568.0000	0.0069	0.0062	0.0062	0.0
29-19A-18	0.1255	0.0	705.0000	1286.0000	1622.0000	0.0090	0.0086	0.0086	0.0
29-19A-19	0.1282	0.0	698.0000	1356.0000	1636.0000	0.0091	0.0088	0.0088	0.0
29-19A-20	0.1283	0.0	746.0000	1345.0000	1627.0000	0.0090	0.0088	0.0088	0.0
29-19A-21	0.1258	0.0	616.0000	1314.0000	1593.0000	0.0088	0.0087	0.0087	0.0
29-19A-22	0.1693	0.0	630.0000	1454.0000	1783.0000	0.0115	0.0117	0.0117	0.0
29-19A-23	0.2077	0.0	613.0000	1532.0000	1872.0000	0.0139	0.0143	0.0143	0.0
29-19A-24	0.2457	0.0	590.0000	1515.0000	1872.0000	0.0163	0.0169	0.0169	0.0
29-19A-25	0.0902	0.0	616.0000	1150.0000	1458.0000	0.0066	0.0062	0.0062	0.0
29-19A-26	0.0908	0.0	618.0000	1290.0000	1588.0000	0.0065	0.0063	0.0063	0.0
29-19A-27	0.1275	0.0	600.0000	1403.0000	1720.0000	0.0089	0.0088	0.0088	0.0
29-19A-28	0.1756	0.0	556.0000	1367.0000	1711.0000	0.0115	0.0121	0.0121	0.0
29-19A-29	0.2091	0.0	541.0000	1349.0000	1648.0000	0.0139	0.0144	0.0144	0.0
29-19A-30	0.0947	0.0	571.0000	1325.0000	1586.0000	0.0067	0.0065	0.0065	0.0
29-19A-31	0.1276	0.0	555.0000	1340.0000	1669.0000	0.0089	0.0088	0.0088	0.0
29-19A-32	0.1075	0.0	570.0000	1334.0000	1570.0000	0.0074	0.0074	0.0074	0.0
29-19A-33	0.1496	0.0	550.0000	1374.0000	1620.0000	0.0102	0.0103	0.0103	0.0
29-19A-34	0.1343	0.0	630.0000	1277.0000	1760.0000	0.0097	0.0092	0.0092	0.0
29-19A-35	0.1350	0.0	622.0000	1435.0000	1871.0000	0.0101	0.0093	0.0093	0.0
29-19A-36	0.1522	0.0	631.0000	1470.0000	1886.0000	0.0114	0.0105	0.0105	0.0
29-19A-37	0.1810	0.0	615.0000	1477.0000	1918.0000	0.0130	0.0125	0.0125	0.0
29-19A-38	0.2258	0.0	593.0000	1324.0000	1716.0000	0.0162	0.0155	0.0155	0.0
29-19A-39	0.2200	0.0	637.0000	1468.0000	1913.0000	0.0153	0.0151	0.0151	0.0
29-19A-40	0.1933	0.0	638.0000	1477.0000	1902.0000	0.0147	0.0133	0.0133	0.0
29-19A-41	0.1587	0.0	616.0000	1463.0000	1778.0000	0.0121	0.0109	0.0109	0.0
29-19A-42	0.2109	0.0	705.0000	1449.0000	1765.0000	0.0152	0.0145	0.0145	0.0
29-19A-43	0.2584	0.0	673.0000	1414.0000	1753.0000	0.0165	0.0178	0.0178	0.0
29-19A-44	0.2459	0.0	708.0000	1429.0000	1769.0000	0.0162	0.0169	0.0169	0.0
29-19A-45	0.2075	0.0	730.0000	1434.0000	1763.0000	0.0140	0.0143	0.0143	0.0
29-20A-1	0.1250	0.0	625.0000	1515.0000	1593.0000	0.0086	0.0086	0.0086	0.0
29-20A-2	0.1656	0.0	641.0000	1678.0000	1629.0000	0.0109	0.0114	0.0114	0.0
29-20A-3	0.2052	0.0	643.0000	1776.0000	1676.0000	0.0135	0.0141	0.0141	0.0
29-20A-4	0.2424	0.0	641.0000	1712.0000	1650.0000	0.0161	0.0167	0.0167	0.0
29-20A-5	0.2808	0.0	632.0000	1669.0000	1573.0000	0.0187	0.0193	0.0193	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EGR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
1271	29-20A-6	0.1261	0.0	623.0000	1491.0000	1537.0000	0.0087	0.0087	0.0	0.0087
1272	29-20A-7	0.1603	0.0	636.0000	1625.0000	1623.0000	0.0108	0.0110	0.0	0.0110
1273	29-20A-8	0.1965	0.0	645.0000	1778.0000	1661.0000	0.0130	0.0135	0.0	0.0135
1274	29-20A-9	0.2317	0.0	642.0000	1703.0000	1645.0000	0.0155	0.0159	0.0	0.0159
1275	29-20A-10	0.2696	0.0	634.0000	1671.0000	1595.0000	0.0179	0.0185	0.0	0.0185
1276	29-20A-11	0.2876	0.0	635.0000	1638.0000	1550.0000	0.0192	0.0198	0.0	0.0198
1278	29-21A-1	0.0903	0.0	606.0000	1541.0000	1424.0000	0.0068	0.0062	0.0062	0.0
1279	29-21A-2	0.1345	0.0	604.0000	1904.0000	1742.0000	0.0091	0.0093	0.0093	0.0
1280	29-21A-3	0.1798	0.0	592.0000	1642.0000	1575.0000	0.0121	0.0124	0.0124	0.0
1281	29-21A-4	0.2177	0.0	582.0000	1396.0000	1480.0000	0.0147	0.0150	0.0150	0.0
1282	29-21A-5	0.1827	0.0	584.0000	1472.0000	1519.0000	0.0124	0.0126	0.0126	0.0
1283	29-21A-6	0.1610	0.0	584.0000	1542.0000	1534.0000	0.0110	0.0111	0.0111	0.0
1284	29-21A-7	0.1333	0.0	591.0000	1744.0000	1522.0000	0.0096	0.0092	0.0092	0.0
1285	29-21A-8	0.1977	0.0	574.0000	1219.0000	1300.0000	0.0136	0.0136	0.0136	0.0
1286	29-21A-9	0.1119	0.0	597.0000	1850.0000	1511.0000	0.0080	0.0077	0.0077	0.0
1287	29-21A-10	0.0689	0.0	599.0000	1770.0000	1337.0000	0.0055	0.0047	0.0047	0.0
1288	29-21A-11	0.0901	0.0	588.0000	1433.0000	1411.0000	0.0066	0.0062	0.0062	0.0
1289	29-21A-12	0.1106	0.0	584.0000	1036.0000	1602.0000	0.0080	0.0076	0.0076	0.0
1290	29-21A-13	0.1361	0.0	578.0000	928.0000	1681.0000	0.0099	0.0094	0.0094	0.0
1291	29-21A-14	0.1616	0.0	576.0000	888.0000	1636.0000	0.0113	0.0111	0.0111	0.0
1292	29-21A-15	0.1856	0.0	568.0000	838.0000	1498.0000	0.0130	0.0128	0.0128	0.0
1294	29-22A-1	0.1467	0.0	809.0000	640.0000	895.0000	0.0096	0.0101	0.0101	0.0
1295	29-22A-2	0.1751	0.0	816.0000	656.0000	920.0000	0.0114	0.0120	0.0120	0.0
1296	29-22A-3	0.2072	0.0	828.0000	679.0000	1027.0000	0.0137	0.0143	0.0143	0.0
1297	29-22A-4	0.2388	0.0	831.0000	693.0000	1133.0000	0.0157	0.0164	0.0164	0.0
1298	29-22A-5	0.2703	0.0	805.0000	691.0000	1219.0000	0.0177	0.0186	0.0186	0.0
1299	29-22A-6	0.1114	0.0	776.0000	640.0000	807.0000	0.0077	0.0077	0.0077	0.0
1300	29-22A-7	0.1440	0.0	813.0000	651.0000	908.0000	0.0096	0.0099	0.0099	0.0
1301	29-22A-8	0.2075	0.0	825.0000	694.0000	1604.0000	0.0134	0.0143	0.0143	0.0
1303	29-23A-1	0.1299	0.0	331.0000	980.0000	1512.0000	0.0094	0.0089	0.0089	0.0
1304	29-23A-2	0.1791	0.0	346.0000	1529.0000	1486.0000	0.0125	0.0123	0.0123	0.0
1305	29-23A-3	0.2149	0.0	328.0000	1465.0000	1150.0000	0.0155	0.0148	0.0148	0.0
1306	29-23A-4	0.1309	0.0	330.0000	1480.0000	1360.0000	0.0100	0.0090	0.0090	0.0
1307	29-23A-5	0.1612	0.0	622.0000	1696.0000	1551.0000	0.0119	0.0111	0.0111	0.0
1308	29-23A-6	0.2118	0.0	588.0000	1584.0000	1460.0000	0.0152	0.0146	0.0146	0.0
1310	29-24A-1	0.2201	0.0	566.0000	0.0	1197.0000	0.0164	0.0151	0.0151	0.0
1311	29-24A-2	0.2622	0.0	563.0000	0.0	1186.0000	0.0197	0.0180	0.0180	0.0
1312	29-24A-3	0.1854	0.0	589.0000	0.0	1210.0000	0.0144	0.0128	0.0128	0.0
1313	29-24A-4	0.1530	0.0	590.0000	0.0	1225.0000	0.0126	0.0105	0.0105	0.0
1314	29-24A-5	0.1145	0.0	617.0000	0.0	1233.0000	0.0106	0.0079	0.0079	0.0
1315	29-24A-6	0.1201	0.0	354.0000	0.0	931.0000	0.0091	0.0083	0.0083	0.0
1316	29-24A-7	0.1486	0.0	346.0000	0.0	934.0000	0.0114	0.0102	0.0102	0.0
1317	29-24A-8	0.1763	0.0	340.0000	0.0	952.0000	0.0128	0.0121	0.0121	0.0
1318	29-24A-9	0.2102	0.0	336.0000	0.0	956.0000	0.0146	0.0145	0.0145	0.0
1319	29-24A-10	0.2492	0.0	330.0000	0.0	962.0000	0.0172	0.0171	0.0171	0.0
1321	29-25A-1	0.1143	0.0	626.0000	0.0	1503.0000	0.0083	0.0079	0.0079	0.0
1322	29-25A-2	0.2255	0.0	606.0000	0.0	1826.0000	0.0149	0.0155	0.0155	0.0
1323	29-25A-3	0.2723	0.0	614.0000	0.0	1930.0000	0.0181	0.0187	0.0187	0.0
1324	29-25A-4	0.3195	0.0	605.0000	0.0	1905.0000	0.0215	0.0220	0.0220	0.0
1325	29-25A-5	0.3691	0.0	608.0000	0.0	1864.0000	0.0244	0.0254	0.0254	0.0
1326	29-25A-6	0.4187	0.0	600.0000	0.0	1812.0000	0.0277	0.0288	0.0288	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-25A-7	0.4496	0.0	597.0000	0.0	1771.0000	0.0297	0.0309	0.0309	0.0
29-26A-1	0.2620	0.0	551.0000	1961.0000	1420.0000	0.0175	0.0180	0.0180	0.0
29-26A-2	0.1599	0.0	570.0000	1802.0000	1207.0000	0.0113	0.0110	0.0110	0.0
29-26A-3	0.3605	0.0	542.0000	1940.0000	1459.0000	0.0242	0.0248	0.0248	0.0
29-27A-1	0.2732	0.0	486.0000	1702.0000	1266.0000	0.0182	0.0188	0.0188	0.0
29-27A-2	0.2760	0.0	485.0000	1789.0000	1155.0000	0.0181	0.0190	0.0190	0.0
29-27A-3	0.2767	0.0	488.0000	1569.0000	1230.0000	0.0182	0.0190	0.0190	0.0
29-27A-4	0.3657	0.0	491.0000	1921.0000	1554.0000	0.0247	0.0252	0.0252	0.0
29-27A-5	0.3477	0.0	498.0000	1891.0000	1501.0000	0.0233	0.0239	0.0	0.0239
29-28A-1	0.1636	0.0	604.0000	1811.0000	1681.0000	0.0101	0.0113	0.0113	0.0
29-28A-2	0.2167	0.0	581.0000	2020.0000	1834.0000	0.0125	0.0149	0.0149	0.0
29-28A-3	0.2656	0.0	570.0000	2041.0000	1908.0000	0.0155	0.0183	0.0183	0.0
29-28A-4	0.3143	0.0	566.0000	2021.0000	1883.0000	0.0193	0.0216	0.0216	0.0
29-28A-5	0.3614	0.0	558.0000	1928.0000	1840.0000	0.0222	0.0249	0.0249	0.0
29-28A-6	0.3888	0.0	551.0000	1857.0000	1821.0000	0.0263	0.0268	0.0268	0.0
29-28A-7	0.1638	0.0	599.0000	1856.0000	1668.0000	0.0116	0.0113	0.0113	0.0
29-28A-8	0.1367	0.0	599.0000	1615.0000	1561.0000	0.0098	0.0094	0.0094	0.0
29-28A-9	0.1100	0.0	597.0000	1046.0000	1445.0000	0.0081	0.0076	0.0076	0.0
29-28A-10	0.2180	0.0	572.0000	1935.0000	1707.0000	0.0148	0.0150	0.0150	0.0
29-28A-11	0.1967	0.0	577.0000	1919.0000	1764.0000	0.0131	0.0135	0.0135	0.0
29-28A-12	0.2479	0.0	564.0000	1929.0000	1730.0000	0.0167	0.0171	0.0171	0.0
29-28A-13	0.2719	0.0	560.0000	1897.0000	1493.0000	0.0182	0.0187	0.0187	0.0
29-28A-14	0.2918	0.0	559.0000	1872.0000	1285.0000	0.0197	0.0201	0.0201	0.0
29-28A-15	0.2838	0.0	567.0000	2031.0000	1744.0000	0.0201	0.0195	0.0	0.0195
29-28A-16	0.3280	0.0	549.0000	1964.0000	1727.0000	0.0228	0.0226	0.0	0.0226
29-28A-17	0.3833	0.0	541.0000	1853.0000	1424.0000	0.0261	0.0264	0.0	0.0264
29-28A-18	0.3556	0.0	544.0000	1910.0000	1374.0000	0.0246	0.0245	0.0	0.0245
29-28A-19	0.2987	0.0	556.0000	2017.0000	1654.0000	0.0211	0.0205	0.0	0.0205
29-28A-20	0.2823	0.0	559.0000	2028.0000	1758.0000	0.0196	0.0194	0.0	0.0194
29-29A-1	0.1285	0.0	615.0000	1673.0000	1585.0000	0.0082	0.0088	0.0	0.0088
29-29A-2	0.1382	0.0	619.0000	1637.0000	1500.0000	0.0097	0.0095	0.0	0.0095
29-29A-3	0.1498	0.0	619.0000	1796.0000	1638.0000	0.0105	0.0103	0.0	0.0103
29-29A-4	0.2043	0.0	638.0000	1956.0000	1805.0000	0.0144	0.0141	0.0	0.0141
29-29A-5	0.1253	0.0	629.0000	1075.0000	1369.0000	0.0088	0.0086	0.0	0.0086
29-30A-1	0.2370	0.0	608.0000	1861.0000	0.0	0.0167	0.0163	0.0	0.0163
29-30A-2	0.2793	0.0	600.0000	1820.0000	0.0	0.0196	0.0192	0.0	0.0192
29-30A-3	0.3229	0.0	585.0000	1761.0000	0.0	0.0227	0.0222	0.0	0.0222
29-30A-4	0.3696	0.0	583.0000	1681.0000	0.0	0.0256	0.0254	0.0	0.0254
29-30A-5	0.3686	0.0	553.0000	1451.0000	0.0	0.0257	0.0254	0.0	0.0254
29-30A-6	0.3700	0.0	545.0000	1215.0000	0.0	0.0256	0.0255	0.0	0.0255
29-31A-1	0.3728	0.0	594.0000	1663.0000	0.0	0.0246	0.0256	0.0	0.0256
29-31A-2	0.3552	0.0	594.0000	1591.0000	0.0	0.0249	0.0244	0.0	0.0244
29-32A-1	0.3723	0.0	524.0000	1383.0000	939.0000	0.0261	0.0256	0.0	0.0256
29-32A-2	0.2845	0.0	555.0000	1641.0000	1199.0000	0.0204	0.0196	0.0	0.0196
29-33A-1	0.2058	0.0	533.0000	1872.0000	1717.0000	0.0134	0.0142	0.0142	0.0
29-33A-2	0.2547	0.0	544.0000	1810.0000	1702.0000	0.0163	0.0175	0.0175	0.0
29-33A-3	0.2735	0.0	543.0000	1725.0000	6711.0000	0.0175	0.0188	0.0188	0.0
29-33A-4	0.2937	0.0	487.0000	1590.0000	1623.0000	0.0190	0.0202	0.0202	0.0
29-33A-5	0.3195	0.0	440.0000	1491.0000	1523.0000	0.0204	0.0220	0.0220	0.0
29-33A-6	0.1947	0.0	577.0000	1877.0000	1649.0000	0.0131	0.0134	0.0	0.0134
29-33A-7	0.2400	0.0	559.0000	1822.0000	1664.0000	0.0161	0.0165	0.0	0.0165

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EOR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-33A-8	0.2671	0.0	546.0000	1729.0000	1611.0000	0.0180	0.0184	0.0	0.0184
29-33A-9	0.2845	0.0	527.0000	1595.0000	1519.0000	0.0195	0.0196	0.0	0.0196
29-33A-10	0.2573	0.0	534.0000	1530.0000	1423.0000	0.0174	0.0177	0.0	0.0177
29-33A-11	0.2834	0.0	508.0000	1409.0000	1330.0000	0.0192	0.0195	0.0	0.0195
29-34A-1	0.0	628.0000	0.0	601.0000	600.0000	0.0	0.0	0.0	0.0
29-35A-1	0.1675	571.0000	0.0	1855.0000	1661.0000	0.0115	0.0115	0.0	0.0115
29-35A-2	0.1960	556.0000	0.0	1953.0000	1774.0000	0.0134	0.0135	0.0	0.0135
29-35A-3	0.2606	556.0000	0.0	1934.0000	1886.0000	0.0176	0.0179	0.0	0.0179
29-35A-4	0.3281	533.0000	0.0	1889.0000	1941.0000	0.0220	0.0226	0.0	0.0226
29-35A-5	0.3885	539.0000	0.0	1736.0000	2043.0000	0.0262	0.0267	0.0	0.0267
29-35A-6	0.4153	525.0000	0.0	1604.0000	2039.0000	0.0	0.0286	0.0	0.0286
29-36A-1	0.2344	548.0000	0.0	1912.0000	1857.0000	0.0160	0.0161	0.0	0.0161
29-36A-2	0.2741	537.0000	0.0	1728.0000	1810.0000	0.0189	0.0189	0.0	0.0189
29-36A-3	0.2963	529.0000	0.0	1559.0000	1756.0000	0.0205	0.0204	0.0	0.0204
29-36A-4	0.3178	524.0000	0.0	1511.0000	1735.0000	0.0215	0.0219	0.0	0.0219
29-36A-5	0.3396	520.0000	0.0	1469.0000	1738.0000	0.0228	0.0234	0.0	0.0234
29-36A-6	0.3519	518.0000	0.0	1449.0000	1746.0000	0.0248	0.0242	0.0	0.0242
29-36A-7	0.3746	509.0000	0.0	1424.0000	1718.0000	0.0246	0.0258	0.0	0.0258
29-36A-8	0.2058	545.0000	0.0	1920.0000	1811.0000	0.0144	0.0142	0.0	0.0142
29-36A-9	0.1873	564.0000	0.0	1925.0000	1728.0000	0.0129	0.0129	0.0	0.0129
29-36A-10	0.1640	556.0000	0.0	1822.0000	1624.0000	0.0113	0.0113	0.0	0.0113
29-36A-11	0.1419	558.0000	0.0	1703.0000	1542.0000	0.0099	0.0098	0.0	0.0098
29-36A-12	0.1201	563.0000	0.0	1552.0000	1436.0000	0.0086	0.0083	0.0	0.0083
29-37A-1	0.2000	548.0000	0.0	1517.0000	1741.0000	0.0135	0.0138	0.0	0.0138
29-37A-2	0.2384	535.0000	0.0	1412.0000	1706.0000	0.0159	0.0164	0.0	0.0164
29-37A-3	0.2563	530.0000	0.0	1362.0000	1656.0000	0.0171	0.0176	0.0	0.0176
29-37A-4	0.2738	530.0000	0.0	1315.0000	1520.0000	0.0180	0.0188	0.0	0.0188
29-37A-5	0.2920	522.0000	0.0	1296.0000	1429.0000	0.0196	0.0201	0.0	0.0201
29-37A-6	0.3111	514.0000	0.0	1254.0000	1293.0000	0.0205	0.0214	0.0	0.0214
29-37A-7	0.1818	546.0000	0.0	1301.0000	1731.0000	0.0123	0.0125	0.0	0.0125
29-37A-8	0.1449	587.0000	0.0	1556.0000	1634.0000	0.0099	0.0100	0.0	0.0100
29-37A-9	0.2068	551.0000	0.0	1506.0000	1677.0000	0.0133	0.0142	0.0142	0.0
29-37A-10	0.2457	539.0000	0.0	1452.0000	1589.0000	0.0161	0.0169	0.0169	0.0
29-37A-11	0.2847	525.0000	0.0	1376.0000	1427.0000	0.0185	0.0196	0.0196	0.0
29-37A-12	0.3049	519.0000	0.0	1341.0000	1333.0000	0.0198	0.0210	0.0210	0.0
29-37A-13	0.2652	521.0000	0.0	1323.0000	1484.0000	0.0174	0.0182	0.0182	0.0
29-37A-14	0.3218	503.0000	0.0	1261.0000	1503.0000	0.0209	0.0221	0.0221	0.0
29-37A-15	0.1882	540.0000	0.0	1344.0000	1746.0000	0.0121	0.0129	0.0129	0.0
29-37A-16	0.1484	576.0000	0.0	1764.0000	1602.0000	0.0095	0.0102	0.0102	0.0
29-37A-17	0.0984	579.0000	0.0	1563.0000	1400.0000	0.0069	0.0068	0.0068	0.0
29-38A-1	0.2245	580.0000	0.0	1819.0000	1773.0000	0.0000	0.0154	0.0	0.0154
29-38A-2	0.2596	577.0000	0.0	1745.0000	1720.0000	0.0000	0.0179	0.0	0.0179
29-38A-3	0.2596	580.0000	0.0	1751.0000	1700.0000	0.0000	0.0179	0.0	0.0179
29-38A-4	0.2918	576.0000	0.0	1722.0000	1653.0000	0.0000	0.0201	0.0	0.0201
29-38A-5	0.3117	580.0000	0.0	1684.0000	1632.0000	0.0000	0.0214	0.0	0.0214
29-38A-6	0.2230	581.0000	0.0	1823.0000	1757.0000	0.0061	0.0153	0.0	0.0153
29-38A-7	0.2318	581.0000	0.0	1812.0000	1754.0000	0.0148	0.0160	0.0160	0.0
29-38A-8	0.2685	575.0000	0.0	1716.0000	1686.0000	0.0169	0.0185	0.0185	0.0
29-38A-9	0.3055	585.0000	0.0	1716.0000	1666.0000	0.0193	0.0210	0.0210	0.0
29-38A-10	0.2454	577.0000	0.0	1711.0000	1720.0000	0.0156	0.0169	0.0169	0.0
29-38A-11	0.2728	576.0000	0.0	1719.0000	1676.0000	0.0172	0.0188	0.0	0.0188

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
1441	29-38A-12	0.2574	576.0000	0.0	1720.0000	1692.0000	0.0167	0.0177	0.0	0.0177
1470	29-38A-13	0.2322	556.0000	0.0	1660.0000	1703.0000	0.0154	0.0160	0.0	0.0160
1471	29-38A-14	0.2672	546.0000	0.0	1783.0000	1661.0000	0.0173	0.0184	0.0	0.0184
1472	29-38A-15	0.2856	548.0000	0.0	1760.0000	1648.0000	0.0186	0.0196	0.0	0.0196
1473	29-38A-16	0.3025	556.0000	0.0	1702.0000	1685.0000	0.0198	0.0208	0.0	0.0208
1474	29-38A-17	0.3219	554.0000	0.0	1618.0000	1663.0000	0.0212	0.0221	0.0	0.0221
1475	29-38A-18	0.3404	556.0000	0.0	1606.0000	1624.0000	0.0224	0.0234	0.0	0.0234
1476	29-38A-19	0.2177	563.0000	0.0	1848.0000	1737.0000	0.0144	0.0150	0.0150	0.0
1477	29-38A-20	0.2434	555.0000	0.0	1812.0000	1680.0000	0.0162	0.0167	0.0167	0.0
1478	29-38A-21	0.2575	554.0000	0.0	1785.0000	1653.0000	0.0172	0.0177	0.0177	0.0
1479	29-38A-22	0.2756	554.0000	0.0	1749.0000	1627.0000	0.0184	0.0190	0.0190	0.0
1480	29-38A-23	0.2929	553.0000	0.0	1705.0000	1609.0000	0.0193	0.0202	0.0202	0.0
1481	29-38A-24	0.2243	553.0000	0.0	1751.0000	1657.0000	0.0154	0.0154	0.0154	0.0
1482	29-38A-25	0.2526	548.0000	0.0	1666.0000	1612.0000	0.0176	0.0174	0.0174	0.0
1483	29-38A-26	0.2679	536.0000	0.0	1643.0000	1599.0000	0.0182	0.0184	0.0184	0.0
1484	29-38A-27	0.2729	543.0000	0.0	1605.0000	1585.0000	0.0191	0.0188	0.0188	0.0
1485	29-38A-28	0.2857	537.0000	0.0	1601.0000	1582.0000	0.0197	0.0197	0.0197	0.0
1486	29-38A-29	0.3016	543.0000	0.0	1586.0000	1589.0000	0.0204	0.0207	0.0207	0.0
1444	29-39A-1	0.2592	604.0000	0.0	1285.0000	0.0	0.0166	0.0178	0.0	0.0178
1445	29-39A-2	0.2580	606.0000	0.0	1255.0000	0.0	0.0166	0.0178	0.0	0.0178
1446	29-39A-3	0.2713	600.0000	0.0	1275.0000	0.0	0.0176	0.0187	0.0	0.0187
1447	29-39A-4	0.2882	588.0000	0.0	1300.0000	0.0	0.0186	0.0198	0.0	0.0198
1448	29-39A-5	0.3088	590.0000	0.0	1347.0000	0.0	0.0203	0.0212	0.0	0.0212
1450	29-40A-1	0.2902	610.0000	0.0	1573.0000	0.0	0.0188	0.0200	0.0	0.0200
1451	29-40A-2	0.3309	629.0000	0.0	1655.0000	0.0	0.0213	0.0228	0.0	0.0228
1452	29-40A-3	0.3735	639.0000	0.0	1711.0000	0.0	0.0241	0.0257	0.0	0.0257
1453	29-40A-4	0.4761	641.0000	0.0	1800.0000	0.0	0.0304	0.0328	0.0	0.0328
1454	29-40A-5	0.4946	635.0000	0.0	1758.0000	0.0	0.0313	0.0340	0.0	0.0340
1455	29-40A-6	0.5331	635.0000	0.0	1731.0000	0.0	0.0337	0.0367	0.0	0.0367
1456	29-40A-7	0.5749	629.0000	0.0	1709.0000	0.0	0.0359	0.0396	0.0	0.0396
1457	29-40A-8	0.6178	628.0000	0.0	1658.0000	0.0	0.0389	0.0425	0.0	0.0425
1458	29-40A-9	0.2646	611.0000	0.0	1514.0000	0.0	0.0173	0.0182	0.0	0.0182
1459	29-40A-10	0.2455	597.0000	0.0	1423.0000	0.0	0.0161	0.0169	0.0	0.0169
1460	29-40A-11	0.2253	607.0000	0.0	1396.0000	0.0	0.0150	0.0155	0.0	0.0155
1462	29-41A-1	0.5258	523.0000	0.0	1752.0000	0.0	0.0339	0.0362	0.0	0.0362
1463	29-41A-2	0.5427	522.0000	0.0	1716.0000	0.0	0.0355	0.0373	0.0	0.0373
1464	29-41A-3	0.4749	537.0000	0.0	1655.0000	0.0	0.0310	0.0327	0.0	0.0327
1465	29-41A-4	0.4248	540.0000	0.0	1679.0000	0.0	0.0283	0.0292	0.0	0.0292
1466	29-42A-1	0.4248	548.0000	0.0	1874.0000	0.0	0.0283	0.0292	0.0	0.0292
1467	29-42A-2	0.4610	542.0000	0.0	1899.0000	0.0	0.0304	0.0317	0.0	0.0317
1468	29-42A-3	0.5114	542.0000	0.0	1862.0000	0.0	0.0330	0.0352	0.0	0.0352
1488	29-43A-1	0.2426	513.0000	0.0	1865.0000	1751.0000	0.0161	0.0167	0.0	0.0167
1489	29-43A-2	0.2903	512.0000	0.0	1856.0000	1759.0000	0.0191	0.0200	0.0	0.0200
1490	29-43A-3	0.3371	510.0000	0.0	1742.0000	1773.0000	0.0222	0.0232	0.0	0.0232
1491	29-43A-4	0.3629	510.0000	0.0	1729.0000	1784.0000	0.0235	0.0250	0.0	0.0250
1492	29-43A-5	0.3803	511.0000	0.0	1731.0000	1793.0000	0.0248	0.0262	0.0	0.0262
1493	29-43A-6	0.4040	512.0000	0.0	1735.0000	1794.0000	0.0260	0.0278	0.0	0.0278
1494	29-43A-7	0.4199	504.0000	0.0	1728.0000	1795.0000	0.0271	0.0289	0.0	0.0289
1495	29-43A-8	0.4457	497.0000	0.0	1695.0000	1783.0000	0.0287	0.0307	0.0	0.0307
1496	29-43A-9	0.4669	500.0000	0.0	1643.0000	1737.0000	0.0300	0.0321	0.0	0.0321
1497	29-43A-10	0.3076	500.0000	0.0	1802.0000	1738.0000	0.0200	0.0212	0.0212	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
1498	29-43A-11	0.3501	509.0000	0.0	1715.0000	1764.0000	0.0229	0.0241	0.0241	0.0
1499	29-43A-12	0.3947	507.0000	0.0	1699.0000	1773.0000	0.0254	0.0272	0.0272	0.0
1500	29-43A-13	0.4437	498.0000	0.0	1675.0000	1765.0000	0.0283	0.0305	0.0305	0.0
1501	29-43A-14	0.4134	498.0000	0.0	1709.0000	1802.0000	0.0265	0.0284	0.0284	0.0
1502	29-43A-15	0.3771	495.0000	0.0	1735.0000	1806.0000	0.0246	0.0259	0.0259	0.0
1503	29-43A-16	0.3358	493.0000	0.0	1748.0000	1803.0000	0.0224	0.0231	0.0231	0.0
1504	29-43A-17	0.2955	493.0000	0.0	1827.0000	1748.0000	0.0196	0.0203	0.0203	0.0
1505	29-43A-18	0.2511	499.0000	0.0	1882.0000	1764.0000	0.0164	0.0173	0.0173	0.0
1507	29-44A-1	0.1922	526.0000	0.0	1670.0000	1675.0000	0.0000	0.0132	0.0	0.0132
1508	29-44A-2	0.2275	509.0000	0.0	1659.0000	1654.0000	0.0000	0.0157	0.0	0.0157
1509	29-44A-3	0.2622	496.0000	0.0	1628.0000	1612.0000	0.0165	0.0180	0.0	0.0180
1510	29-44A-4	0.2794	490.0000	0.0	1616.0000	1589.0000	0.0176	0.0192	0.0	0.0192
1511	29-44A-5	0.2980	487.0000	0.0	1664.0000	1562.0000	0.0187	0.0205	0.0	0.0205
1512	29-44A-6	0.3149	488.0000	0.0	1664.0000	1557.0000	0.0195	0.0217	0.0	0.0217
1513	29-44A-7	0.3327	488.0000	0.0	1667.0000	1532.0000	0.0207	0.0229	0.0	0.0229
1514	29-44A-8	0.3506	487.0000	0.0	1646.0000	1492.0000	0.0217	0.0241	0.0	0.0241
1515	29-44A-9	0.2016	513.0000	0.0	1652.0000	1679.0000	0.0123	0.0139	0.0139	0.0
1516	29-44A-10	0.2352	500.0000	0.0	1601.0000	1633.0000	0.0144	0.0162	0.0162	0.0
1517	29-44A-11	0.2726	495.0000	0.0	1566.0000	1603.0000	0.0167	0.0188	0.0188	0.0
1518	29-44A-12	0.3071	484.0000	0.0	1575.0000	1593.0000	0.0185	0.0211	0.0211	0.0
1519	29-44A-13	0.3275	478.0000	0.0	1601.0000	1563.0000	0.0198	0.0225	0.0225	0.0
1520	29-44A-14	0.2920	486.0000	0.0	1614.0000	1573.0000	0.0178	0.0201	0.0201	0.0
1522	29-45A-1	0.2234	615.0000	0.0	1569.0000	1845.0000	0.0140	0.0154	0.0	0.0154
1523	29-45A-2	0.2597	609.0000	0.0	1576.0000	1891.0000	0.0162	0.0179	0.0	0.0179
1524	29-45A-3	0.2764	603.0000	0.0	1553.0000	1908.0000	0.0172	0.0190	0.0	0.0190
1525	29-45A-4	0.2932	592.0000	0.0	1524.0000	1899.0000	0.0182	0.0202	0.0	0.0202
1526	29-45A-5	0.3107	589.0000	0.0	1493.0000	1872.0000	0.0192	0.0214	0.0	0.0214
1527	29-45A-6	0.1880	615.0000	0.0	1496.0000	1809.0000	0.0119	0.0129	0.0	0.0129
1528	29-45A-7	0.1543	618.0000	0.0	1388.0000	1658.0000	0.0096	0.0106	0.0	0.0106
1529	29-45A-8	0.1625	619.0000	0.0	1403.0000	1679.0000	0.0098	0.0112	0.0112	0.0
1530	29-45A-9	0.1961	622.0000	0.0	1522.0000	1827.0000	0.0125	0.0135	0.0135	0.0
1531	29-45A-10	0.2303	609.0000	0.0	1585.0000	1841.0000	0.0145	0.0158	0.0158	0.0
1532	29-45A-11	0.2679	607.0000	0.0	1566.0000	1857.0000	0.0166	0.0184	0.0184	0.0
1533	29-45A-12	0.2865	600.0000	0.0	1534.0000	1850.0000	0.0183	0.0197	0.0197	0.0
1534	29-45A-13	0.2580	608.0000	0.0	1559.0000	1864.0000	0.0163	0.0178	0.0178	0.0
1536	29-45B-1	0.1890	612.0000	0.0	1497.0000	1816.0000	0.0120	0.0130	0.0	0.0130
1537	29-45B-2	0.2234	603.0000	0.0	1516.0000	1816.0000	0.0141	0.0154	0.0	0.0154
1538	29-45B-3	0.2593	597.0000	0.0	1464.0000	1809.0000	0.0163	0.0178	0.0	0.0178
1539	29-45B-4	0.2760	587.0000	0.0	1439.0000	1792.0000	0.0172	0.0190	0.0	0.0190
1540	29-45B-5	0.2932	574.0000	0.0	1416.0000	1769.0000	0.0185	0.0202	0.0	0.0202
1541	29-45B-6	0.3107	569.0000	0.0	1394.0000	1729.0000	0.0194	0.0214	0.0	0.0214
1542	29-45B-7	0.3271	550.0000	0.0	1362.0000	1661.0000	0.0205	0.0225	0.0	0.0225
1543	29-45B-8	0.1968	615.0000	0.0	1509.0000	1834.0000	0.0124	0.0135	0.0135	0.0
1544	29-45B-9	0.2323	604.0000	0.0	1492.0000	1810.0000	0.0147	0.0160	0.0160	0.0
1545	29-45B-10	0.2654	585.0000	0.0	1450.0000	1800.0000	0.0171	0.0183	0.0183	0.0
1546	29-45B-11	0.2863	582.0000	0.0	1420.0000	1762.0000	0.0183	0.0197	0.0197	0.0
1547	29-45B-12	0.3046	566.0000	0.0	1396.0000	1720.0000	0.0194	0.0210	0.0210	0.0
1549	29-46A-1	0.1318	541.0000	0.0	1957.0000	1328.0000	0.0083	0.0091	0.0	0.0091
1550	29-46A-2	0.1715	536.0000	0.0	1815.0000	1365.0000	0.0108	0.0118	0.0	0.0118
1551	29-46A-3	0.2106	534.0000	0.0	1706.0000	1335.0000	0.0131	0.0145	0.0	0.0145
1552	29-46A-4	0.2484	530.0000	0.0	1673.0000	1391.0000	0.0154	0.0171	0.0	0.0171

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
1553	29-46A-5	0.1339	543.0000	0.0	1859.0000	1434.0000	0.0086	0.0092	0.0092	0.0
1554	29-46A-6	0.1803	534.0000	0.0	1779.0000	1367.0000	0.0109	0.0124	0.0124	0.0
1555	29-46A-7	0.2188	527.0000	0.0	1537.0000	1346.0000	0.0137	0.0151	0.0151	0.0
1556	29-46A-8	0.1988	519.0000	0.0	1522.0000	1317.0000	0.0122	0.0137	0.0137	0.0
1557	29-46A-9	0.1556	529.0000	0.0	1640.0000	1390.0000	0.0098	0.0107	0.0107	0.0
1558	29-46A-10	0.1982	526.0000	0.0	1482.0000	1335.0000	0.0127	0.0136	0.0136	0.0
1559	29-46A-11	0.1785	512.0000	0.0	1496.0000	1316.0000	0.0111	0.0123	0.0123	0.0
1560	29-46A-12	0.1344	533.0000	0.0	1638.0000	1400.0000	0.0087	0.0092	0.0092	0.0
1561	29-46A-13	0.1113	543.0000	0.0	1673.0000	1502.0000	0.0075	0.0077	0.0077	0.0
1563	29-47A-1	0.2269	870.0000	0.0	1821.0000	1663.0000	0.0143	0.0156	0.0	0.0156
1564	29-47A-2	0.2620	848.0000	0.0	1762.0000	1636.0000	0.0163	0.0180	0.0	0.0180
1565	29-47A-3	0.2983	837.0000	0.0	1726.0000	1585.0000	0.0183	0.0205	0.0	0.0205
1566	29-47A-4	0.3142	826.0000	0.0	1719.0000	1555.0000	0.0195	0.0216	0.0	0.0216
1567	29-47A-5	0.3332	811.0000	0.0	1740.0000	1509.0000	0.0205	0.0229	0.0	0.0229
1568	29-47A-6	0.3505	799.0000	0.0	1736.0000	1483.0000	0.0217	0.0241	0.0	0.0241
1569	29-47A-7	0.2345	847.0000	0.0	1795.0000	1670.0000	0.0151	0.0161	0.0161	0.0
1570	29-47A-8	0.2723	842.0000	0.0	1749.0000	1629.0000	0.0167	0.0187	0.0187	0.0
1571	29-47A-9	0.3128	824.0000	0.0	1710.0000	1570.0000	0.0195	0.0215	0.0215	0.0
1572	29-47A-10	0.3279	812.0000	0.0	1705.0000	1525.0000	0.0204	0.0226	0.0226	0.0
1573	29-47A-11	0.2902	825.0000	0.0	1739.0000	1543.0000	0.0180	0.0200	0.0200	0.0
1574	29-47A-12	0.1013	732.0000	0.0	1444.0000	1268.0000	0.0067	0.0070	0.0	0.0070
1575	29-47A-13	0.1060	747.0000	0.0	1495.0000	1298.0000	0.0070	0.0073	0.0073	0.0
1577	29-48A-1	0.2086	690.0000	0.0	1753.0000	1430.0000	0.0127	0.0143	0.0143	0.0
1578	29-48A-2	0.2282	691.0000	0.0	1672.0000	1407.0000	0.0141	0.0157	0.0157	0.0
1579	29-48A-3	0.1905	701.0000	0.0	1770.0000	1456.0000	0.0117	0.0131	0.0131	0.0
1580	29-48A-4	0.1718	712.0000	0.0	1873.0000	1505.0000	0.0106	0.0118	0.0118	0.0
1581	29-48A-5	0.2018	699.0000	0.0	1772.0000	1462.0000	0.0125	0.0139	0.0139	0.0
1582	29-48A-6	0.0868	664.0000	0.0	1588.0000	1077.0000	0.0057	0.0060	0.0060	0.0
1583	29-48A-7	0.1635	710.0000	0.0	1853.0000	1531.0000	0.0102	0.0112	0.0	0.0112
1584	29-48A-8	0.2005	698.0000	0.0	1725.0000	1464.0000	0.0126	0.0138	0.0	0.0138
1585	29-48A-9	0.2376	686.0000	0.0	1630.0000	1434.0000	0.0147	0.0163	0.0	0.0163
1586	29-48A-10	0.1822	698.0000	0.0	1771.0000	1460.0000	0.0114	0.0125	0.0	0.0125
1587	29-49A-1	0.0	583.0000	0.0	584.0000	569.0000	0.0	0.0	0.0	0.0
1589	29-50A-1	0.2218	586.0000	0.0	1704.0000	1325.0000	0.0142	0.0153	0.0153	0.0
1590	29-50A-2	0.2769	602.0000	0.0	1678.0000	1357.0000	0.0182	0.0190	0.0190	0.0
1591	29-50A-3	0.2340	602.0000	0.0	1743.0000	1324.0000	0.0153	0.0161	0.0161	0.0
1593	29-50A-4	0.2127	617.0000	0.0	1734.0000	1540.0000	0.0138	0.0146	0.0	0.0146
1594	29-50A-5	0.2624	611.0000	0.0	1613.0000	1480.0000	0.0169	0.0181	0.0	0.0181
1595	29-50A-6	0.3088	617.0000	0.0	1574.0000	1487.0000	0.0198	0.0212	0.0	0.0212
1596	29-50A-7	0.3609	618.0000	0.0	1490.0000	1458.0000	0.0232	0.0248	0.0	0.0248
1597	29-50A-8	0.2396	597.0000	0.0	1602.0000	1374.0000	0.0157	0.0165	0.0	0.0165
1598	29-50A-9	0.1900	599.0000	0.0	1731.0000	1441.0000	0.0124	0.0131	0.0	0.0131
1599	29-50A-10	0.1631	626.0000	0.0	1721.0000	1584.0000	0.0109	0.0112	0.0	0.0112
1600	29-50A-11	0.1387	613.0000	0.0	1634.0000	1502.0000	0.0092	0.0095	0.0	0.0095
1601	29-50A-12	0.0999	0.0	0.0	1427.0000	1082.0000	0.0064	0.0069	0.0	0.0069
1602	29-50A-13	0.2222	0.0	0.0	1681.0000	1526.0000	0.0144	0.0153	0.0153	0.0
1603	29-50A-14	0.1889	0.0	0.0	1722.0000	1588.0000	0.0121	0.0130	0.0130	0.0
1604	29-50A-15	0.2435	0.0	0.0	1610.0000	1490.0000	0.0159	0.0168	0.0168	0.0
1605	29-50A-16	0.2329	0.0	0.0	1611.0000	1497.0000	0.0149	0.0160	0.0160	0.0
1606	29-50A-17	0.2694	0.0	0.0	1547.0000	1450.0000	0.0176	0.0185	0.0185	0.0
1607	29-50A-18	0.3196	0.0	0.0	1522.0000	1450.0000	0.0205	0.0220	0.0220	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-50A-19	0.2337	0.0	0.0	1566.0000	1370.0000	0.0150	0.0161	0.0161	0.0
29-51A-1	0.2745	0.0	0.0	1284.0000	1390.0000	0.0177	0.0189	0.0189	0.0
29-51A-2	0.2231	0.0	0.0	1204.0000	1331.0000	0.0144	0.0153	0.0153	0.0
29-51A-3	0.1637	0.0	0.0	1285.0000	1378.0000	0.0124	0.0113	0.0113	0.0
29-51A-4	0.1483	0.0	0.0	1369.0000	1357.0000	0.0111	0.0102	0.0102	0.0
29-51A-5	0.1091	0.0	0.0	1405.0000	1354.0000	0.0091	0.0075	0.0075	0.0
29-51A-6	0.2283	0.0	0.0	1561.0000	1483.0000	0.0151	0.0157	0.0157	0.0
29-51A-7	0.1876	0.0	0.0	1655.0000	1435.0000	0.0122	0.0129	0.0129	0.0
29-51A-8	0.1621	0.0	0.0	1721.0000	1493.0000	0.0110	0.0112	0.0112	0.0
29-51A-9	0.1397	0.0	0.0	1747.0000	1542.0000	0.0095	0.0096	0.0096	0.0
29-51A-10	0.1160	0.0	0.0	1688.0000	1546.0000	0.0079	0.0080	0.0080	0.0
29-51A-11	0.2072	0.0	0.0	1652.0000	1434.0000	0.0132	0.0143	0.0143	0.0
29-51A-12	0.1878	0.0	0.0	1660.0000	1456.0000	0.0123	0.0129	0.0129	0.0
29-51A-13	0.1830	0.0	0.0	1707.0000	1466.0000	0.0118	0.0126	0.0126	0.0
29-51A-14	0.1375	0.0	0.0	1736.0000	1535.0000	0.0094	0.0095	0.0	0.0095
29-51A-15	0.1585	0.0	0.0	1703.0000	1501.0000	0.0104	0.0109	0.0	0.0109
29-51A-16	0.1785	0.0	0.0	1671.0000	1453.0000	0.0116	0.0123	0.0	0.0123
29-51A-17	0.1827	0.0	0.0	1634.0000	1436.0000	0.0120	0.0126	0.0	0.0126
29-51A-18	0.1991	0.0	0.0	1595.0000	1405.0000	0.0129	0.0137	0.0	0.0137
29-51A-19	0.2190	0.0	0.0	1554.0000	1394.0000	0.0143	0.0151	0.0	0.0151
29-51A-20	0.2382	0.0	0.0	1431.0000	1415.0000	0.0155	0.0164	0.0	0.0164
29-52A-1	0.3159	0.0	0.0	1696.0000	1211.0000	0.0200	0.0217	0.0217	0.0
29-52A-2	0.2678	0.0	0.0	1767.0000	1171.0000	0.0171	0.0184	0.0184	0.0
29-52A-3	0.2237	0.0	0.0	1804.0000	1139.0000	0.0144	0.0154	0.0154	0.0
29-52A-4	0.2781	0.0	0.0	1749.0000	1250.0000	0.0183	0.0191	0.0191	0.0
29-52A-5	0.3059	0.0	0.0	1697.0000	1254.0000	0.0205	0.0210	0.0210	0.0
29-52A-6	0.3315	0.0	0.0	1672.0000	1279.0000	0.0217	0.0228	0.0228	0.0
29-52A-7	0.3513	0.0	0.0	1621.0000	1279.0000	0.0233	0.0242	0.0242	0.0
29-52A-8	0.2458	0.0	0.0	1782.0000	1165.0000	0.0162	0.0169	0.0169	0.0
29-52A-9	0.2286	0.0	0.0	1779.0000	1147.0000	0.0153	0.0157	0.0157	0.0
29-52A-10	0.2002	0.0	0.0	1783.0000	1097.0000	0.0135	0.0138	0.0138	0.0
29-52A-11	0.3053	0.0	0.0	1658.0000	1263.0000	0.0211	0.0210	0.0	0.0210
29-52A-12	0.2914	0.0	0.0	1714.0000	1229.0000	0.0195	0.0201	0.0	0.0201
29-52A-13	0.2626	0.0	0.0	1769.0000	1193.0000	0.0177	0.0181	0.0	0.0181
29-52A-14	0.2389	0.0	0.0	1784.0000	1142.0000	0.0161	0.0164	0.0	0.0164
29-52A-15	0.2153	0.0	0.0	1778.0000	1111.0000	0.0143	0.0148	0.0	0.0148
29-52A-16	0.1920	0.0	0.0	1780.0000	1053.0000	0.0128	0.0132	0.0	0.0132
29-52A-17	0.3397	0.0	0.0	1619.0000	1256.0000	0.0225	0.0234	0.0	0.0234
29-53A-1	0.0	144.0000	0.0	161.0000	154.0000	0.0	0.0	0.0	0.0
29-54A-1	0.2653	0.0	0.0	1731.0000	666.0000	0.0171	0.0183	0.0183	0.0
29-54A-2	0.2435	0.0	0.0	1722.0000	681.0000	0.0157	0.0168	0.0168	0.0
29-54A-3	0.2175	0.0	0.0	1742.0000	704.0000	0.0142	0.0150	0.0150	0.0
29-54A-4	0.2148	0.0	0.0	1758.0000	731.0000	0.0139	0.0148	0.0148	0.0
29-54A-5	0.2122	0.0	0.0	1774.0000	759.0000	0.0136	0.0146	0.0146	0.0
29-54A-6	0.1980	0.0	0.0	1811.0000	782.0000	0.0130	0.0136	0.0136	0.0
29-54A-7	0.1802	0.0	0.0	1836.0000	794.0000	0.0122	0.0124	0.0124	0.0
29-54A-8	0.1678	0.0	0.0	1848.0000	811.0000	0.0114	0.0115	0.0115	0.0
29-55A-1	0.2506	0.0	0.0	1576.0000	1249.0000	0.0166	0.0172	0.0172	0.0
29-55A-2	0.2085	0.0	0.0	1632.0000	1326.0000	0.0148	0.0143	0.0143	0.0
29-55A-3	0.1984	0.0	0.0	1638.0000	1334.0000	0.0143	0.0136	0.0136	0.0
29-55A-4	0.1792	0.0	0.0	1650.0000	1359.0000	0.0134	0.0123	0.0123	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAQX1	FAQX2
29-55A-5	0.1499	0.0	0.0	1773.0000	1418.0000	0.0113	0.0103	0.0103	0.0
29-55A-6	0.2418	0.0	0.0	1558.0000	1355.0000	0.0167	0.0166	0.0166	0.0
29-55A-7	0.2946	0.0	0.0	1550.0000	1328.0000	0.0199	0.0203	0.0203	0.0
29-55A-8	0.2206	0.0	0.0	1548.0000	1256.0000	0.0156	0.0152	0.0152	0.0
29-55A-9	0.1898	0.0	0.0	1588.0000	1295.0000	0.0133	0.0131	0.0131	0.0
29-55A-10	0.2791	0.0	0.0	1562.0000	1256.0000	0.0176	0.0192	0.0192	0.0
29-55A-11	0.2408	0.0	0.0	1572.0000	1237.0000	0.0157	0.0166	0.0166	0.0
29-55A-12	0.2062	0.0	0.0	1643.0000	1286.0000	0.0139	0.0142	0.0142	0.0
29-55A-13	0.1971	0.0	0.0	1660.0000	1314.0000	0.0136	0.0136	0.0136	0.0
29-55A-14	0.1801	0.0	0.0	1636.0000	1336.0000	0.0126	0.0124	0.0124	0.0
29-55A-15	0.1492	0.0	0.0	1679.0000	1388.0000	0.0113	0.0103	0.0103	0.0
29-55A-16	0.3156	0.0	0.0	1403.0000	1207.0000	0.0197	0.0217	0.0217	0.0
29-55A-17	0.3402	0.0	0.0	1333.0000	1062.0000	0.0206	0.0234	0.0234	0.0
29-55A-18	0.2362	0.0	0.0	1504.0000	1173.0000	0.0165	0.0163	0.0163	0.0
29-55A-19	0.1810	0.0	0.0	1536.0000	1179.0000	0.0132	0.0125	0.0125	0.0
29-55A-20	0.3923	0.0	0.0	1441.0000	1515.0000	0.0250	0.0270	0.0270	0.0
29-56A-1	0.4017	514.0000	0.0	805.0000	742.0000	0.0248	0.0276	0.0276	0.0
29-56A-2	0.3477	517.0000	0.0	831.0000	747.0000	0.0218	0.0239	0.0239	0.0
29-56A-3	0.2852	526.0000	0.0	831.0000	749.0000	0.0192	0.0196	0.0196	0.0
29-56A-4	0.2248	538.0000	0.0	1081.0000	806.0000	0.0156	0.0155	0.0155	0.0
29-56A-5	0.2090	546.0000	0.0	1224.0000	860.0000	0.0141	0.0144	0.0144	0.0
29-56A-6	0.1953	562.0000	0.0	1267.0000	887.0000	0.0132	0.0134	0.0134	0.0
29-56A-7	0.2158	547.0000	0.0	1227.0000	879.0000	0.0145	0.0148	0.0148	0.0
29-56A-8	0.2223	535.0000	0.0	1200.0000	865.0000	0.0149	0.0153	0.0153	0.0
29-56A-9	0.2780	516.0000	0.0	869.0000	768.0000	0.0174	0.0191	0.0191	0.0
29-56A-10	0.2288	521.0000	0.0	924.0000	768.0000	0.0147	0.0157	0.0157	0.0
29-56A-11	0.1960	530.0000	0.0	1127.0000	811.0000	0.0128	0.0135	0.0135	0.0
29-56A-12	0.1768	536.0000	0.0	1210.0000	848.0000	0.0117	0.0122	0.0122	0.0
29-56A-13	0.1646	540.0000	0.0	1208.0000	882.0000	0.0110	0.0113	0.0113	0.0
29-56A-14	0.1614	535.0000	0.0	1168.0000	889.0000	0.0107	0.0111	0.0111	0.0
29-56A-15	0.1533	534.0000	0.0	1187.0000	908.0000	0.0101	0.0105	0.0105	0.0
29-57A-1	0.3155	590.0000	0.0	1760.0000	1428.0000	0.0203	0.0217	0.0	0.0217
29-57A-2	0.3663	578.0000	0.0	1709.0000	1374.0000	0.0231	0.0252	0.0	0.0252
29-57A-3	0.3894	568.0000	0.0	1653.0000	1342.0000	0.0248	0.0268	0.0	0.0268
29-57A-4	0.3703	577.0000	0.0	1696.0000	1360.0000	0.0233	0.0255	0.0	0.0255
29-57A-5	0.3463	576.0000	0.0	1712.0000	1380.0000	0.0220	0.0238	0.0	0.0238
29-57A-6	0.3231	585.0000	0.0	1733.0000	1407.0000	0.0207	0.0222	0.0222	0.0
29-57A-7	0.3449	573.0000	0.0	1698.0000	1372.0000	0.0223	0.0237	0.0237	0.0
29-57A-8	0.3741	565.0000	0.0	1640.0000	1336.0000	0.0242	0.0257	0.0257	0.0
29-57A-9	0.3512	570.0000	0.0	1668.0000	1355.0000	0.0228	0.0242	0.0242	0.0
29-57A-10	0.3593	568.0000	0.0	1652.0000	1350.0000	0.0229	0.0247	0.0247	0.0
29-57A-11	0.2812	582.0000	0.0	1769.0000	1438.0000	0.0179	0.0193	0.0193	0.0
29-57A-12	0.2277	614.0000	0.0	1848.0000	1486.0000	0.0147	0.0157	0.0157	0.0
29-57A-13	0.1671	623.0000	0.0	1671.0000	1320.0000	0.0112	0.0115	0.0115	0.0
29-58A-1	0.3876	0.0	0.0	1832.0000	1406.0000	0.0257	0.0267	0.0267	0.0
29-58A-2	0.3293	0.0	0.0	1824.0000	1447.0000	0.0222	0.0227	0.0227	0.0
29-58A-3	0.4065	0.0	0.0	1804.0000	1424.0000	0.0272	0.0280	0.0280	0.0
29-58A-4	0.4306	0.0	0.0	1728.0000	1380.0000	0.0286	0.0296	0.0296	0.0
29-58A-5	0.4143	0.0	0.0	1826.0000	1374.0000	0.0278	0.0285	0.0285	0.0
29-58A-6	0.4054	0.0	0.0	1784.0000	1374.0000	0.0271	0.0279	0.0279	0.0
29-58A-7	0.3105	0.0	0.0	1832.0000	1454.0000	0.0205	0.0214	0.0	0.0214

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-58A-8	0.3614	0.0	0.0	1846.0000	1416.0000	0.0235	0.0249	0.0	0.0249
29-58A-9	0.3873	0.0	0.0	1834.0000	1403.0000	0.0251	0.0266	0.0	0.0266
29-58A-10	0.4096	0.0	0.0	1807.0000	1392.0000	0.0264	0.0282	0.0	0.0282
29-58A-11	0.4344	0.0	0.0	1799.0000	1370.0000	0.0282	0.0299	0.0	0.0299
29-58A-12	0.4274	0.0	0.0	1803.0000	1346.0000	0.0275	0.0294	0.0	0.0294
29-58A-13	0.4123	0.0	0.0	1821.0000	1340.0000	0.0266	0.0284	0.0	0.0284
29-59A-1	0.3025	0.0	0.0	1332.0000	1227.0000	0.0199	0.0208	0.0208	0.0
29-59A-2	0.2769	0.0	0.0	1285.0000	1212.0000	0.0179	0.0191	0.0191	0.0
29-59A-3	0.2474	0.0	0.0	1380.0000	1226.0000	0.0158	0.0170	0.0170	0.0
29-59A-4	0.2154	0.0	0.0	1568.0000	1281.0000	0.0139	0.0148	0.0148	0.0
29-59A-5	0.1929	0.0	0.0	1622.0000	1311.0000	0.0126	0.0133	0.0133	0.0
29-59A-6	0.1833	0.0	0.0	1645.0000	1342.0000	0.0119	0.0126	0.0126	0.0
29-59A-7	0.2020	0.0	0.0	1620.0000	1347.0000	0.0130	0.0139	0.0139	0.0
29-59A-8	0.2889	0.0	0.0	1443.0000	1316.0000	0.0181	0.0199	0.0	0.0199
29-59A-9	0.2702	0.0	0.0	1419.0000	1285.0000	0.0170	0.0186	0.0	0.0186
29-59A-10	0.2428	0.0	0.0	1490.0000	1295.0000	0.0153	0.0167	0.0	0.0167
29-59A-11	0.2114	0.0	0.0	1552.0000	1325.0000	0.0135	0.0145	0.0	0.0145
29-59A-12	0.2003	0.0	0.0	1563.0000	1323.0000	0.0126	0.0138	0.0	0.0138
29-59A-13	0.1527	0.0	0.0	1690.0000	1377.0000	0.0099	0.0105	0.0	0.0105
29-60A-1	0.2827	0.0	0.0	0.0	1175.0000	0.0189	0.0194	0.0194	0.0
29-60A-2	0.2446	0.0	0.0	0.0	1218.0000	0.0159	0.0168	0.0168	0.0
29-60A-3	0.2169	0.0	0.0	0.0	1415.0000	0.0143	0.0149	0.0149	0.0
29-60A-4	0.1863	0.0	0.0	0.0	1556.0000	0.0129	0.0128	0.0128	0.0
29-60A-5	0.2075	0.0	0.0	0.0	1539.0000	0.0134	0.0143	0.0143	0.0
29-60A-6	0.2710	0.0	0.0	0.0	1280.0000	0.0174	0.0186	0.0	0.0186
29-60A-7	0.2388	0.0	0.0	0.0	1276.0000	0.0155	0.0164	0.0	0.0164
29-60A-8	0.2154	0.0	0.0	0.0	1414.0000	0.0142	0.0148	0.0	0.0148
29-60A-9	0.1835	0.0	0.0	0.0	1503.0000	0.0119	0.0126	0.0	0.0126
29-60A-10	0.1533	0.0	0.0	0.0	1547.0000	0.0101	0.0105	0.0	0.0105
29-60A-11	0.1218	0.0	0.0	0.0	1492.0000	0.0081	0.0084	0.0	0.0084
29-60A-12	0.2861	0.0	0.0	0.0	1320.0000	0.0180	0.0197	0.0	0.0197
29-61A-1	0.3045	0.0	0.0	1425.0000	1457.0000	0.0202	0.0209	0.0209	0.0
29-61A-2	0.2688	0.0	0.0	1573.0000	1410.0000	0.0181	0.0185	0.0185	0.0
29-61A-3	0.2346	0.0	0.0	1671.0000	1422.0000	0.0160	0.0161	0.0161	0.0
29-61A-4	0.2159	0.0	0.0	1696.0000	1451.0000	0.0147	0.0149	0.0149	0.0
29-61A-5	0.1918	0.0	0.0	1795.0000	1523.0000	0.0134	0.0132	0.0132	0.0
29-61A-6	0.2486	0.0	0.0	1658.0000	1448.0000	0.0167	0.0171	0.0171	0.0
29-61A-7	0.2310	0.0	0.0	1663.0000	1459.0000	0.0159	0.0159	0.0159	0.0
29-61A-8	0.2757	0.0	0.0	1603.0000	1412.0000	0.0186	0.0190	0.0190	0.0
29-61A-9	0.2548	0.0	0.0	1633.0000	1394.0000	0.0176	0.0175	0.0	0.0175
29-61A-10	0.2199	0.0	0.0	1693.0000	1441.0000	0.0150	0.0151	0.0	0.0151
29-61A-11	0.1869	0.0	0.0	1731.0000	1494.0000	0.0127	0.0130	0.0	0.0130
29-61A-12	0.2370	0.0	0.0	1679.0000	1395.0000	0.0160	0.0163	0.0	0.0163
29-61A-13	0.2946	0.0	0.0	1528.0000	1363.0000	0.0198	0.0203	0.0	0.0203
29-61A-14	0.3004	0.0	0.0	1502.0000	1584.0000	0.0195	0.0207	0.0207	0.0
29-61A-15	0.2337	0.0	0.0	1609.0000	1561.0000	0.0153	0.0161	0.0161	0.0
29-61A-16	0.2078	0.0	0.0	1710.0000	1587.0000	0.0137	0.0143	0.0143	0.0
29-61A-17	0.2446	0.0	0.0	1645.0000	1524.0000	0.0158	0.0166	0.0166	0.0
29-61A-18	0.2540	0.0	0.0	1632.0000	1530.0000	0.0165	0.0175	0.0175	0.0
29-61A-19	0.2699	0.0	0.0	1600.0000	1500.0000	0.0175	0.0186	0.0186	0.0
29-61A-20	0.2397	0.0	0.0	1640.0000	1511.0000	0.0156	0.0165	0.0165	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-61A-21	0.2311	0.0	0.0	1613.0000	1507.0000	0.0153	0.0159	0.0159	0.0
29-61A-22	0.2761	0.0	0.0	1512.0000	1523.0000	0.0181	0.0190	0.0	0.0190
29-61A-23	0.2452	0.0	0.0	1659.0000	1527.0000	0.0159	0.0169	0.0	0.0169
29-61A-24	0.2115	0.0	0.0	1696.0000	1561.0000	0.0139	0.0146	0.0	0.0146
29-61A-25	0.1769	0.0	0.0	1708.0000	1660.0000	0.0116	0.0122	0.0	0.0122
29-61A-26	0.2284	0.0	0.0	1653.0000	1527.0000	0.0148	0.0157	0.0	0.0157
29-61A-27	0.2356	0.0	0.0	1614.0000	1517.0000	0.0153	0.0162	0.0	0.0162
29-62A-1	0.2958	623.0000	0.0	1656.0000	1332.0000	0.0196	0.0204	0.0	0.0204
29-62A-2	0.2608	624.0000	0.0	1571.0000	1259.0000	0.0173	0.0179	0.0	0.0179
29-62A-3	0.2209	618.0000	0.0	1493.0000	1181.0000	0.0148	0.0152	0.0	0.0152
29-63A-1	0.0	596.0000	593.0000	588.0000	592.0000	0.0	0.0	0.0	0.0
29-64A-1	0.3665	661.0000	1852.0000	0.0	0.0	0.0245	0.0252	0.0	0.0252
29-64A-2	0.3638	678.0000	1842.0000	0.0	0.0	0.0244	0.0250	0.0	0.0250
29-64A-3	0.3151	673.0000	1764.0000	1690.0000	0.0	0.0218	0.0217	0.0	0.0217
29-64A-4	0.2853	662.0000	1677.0000	1634.0000	0.0	0.0194	0.0196	0.0	0.0196
29-64A-5	0.2413	639.0000	1578.0000	1520.0000	0.0	0.0170	0.0166	0.0	0.0166
29-64A-6	0.1987	633.0000	1482.0000	1420.0000	0.0	0.0139	0.0137	0.0	0.0137
29-65A-1	0.2844	0.0	1371.0000	1163.0000	0.0	0.0174	0.0196	0.0196	0.0
29-65A-2	0.2809	0.0	1495.0000	1195.0000	0.0	0.0180	0.0193	0.0193	0.0
29-65A-3	0.2511	0.0	1481.0000	1202.0000	0.0	0.0162	0.0173	0.0173	0.0
29-65A-4	0.2233	0.0	1550.0000	1233.0000	0.0	0.0147	0.0154	0.0154	0.0
29-65A-5	0.1842	0.0	1718.0000	1314.0000	0.0	0.0124	0.0127	0.0127	0.0
29-65A-6	0.1978	0.0	1665.0000	1303.0000	0.0	0.0132	0.0136	0.0136	0.0
29-65A-7	0.2227	0.0	1618.0000	1278.0000	0.0	0.0143	0.0153	0.0153	0.0
29-65A-8	0.2301	0.0	1591.0000	1265.0000	0.0	0.0149	0.0158	0.0158	0.0
29-65A-9	0.2753	0.0	1481.0000	1182.0000	0.0	0.0176	0.0189	0.0	0.0189
29-65A-10	0.2428	0.0	1426.0000	1159.0000	0.0	0.0161	0.0167	0.0	0.0167
29-65A-11	0.2162	0.0	1586.0000	1269.0000	0.0	0.0142	0.0149	0.0	0.0149
29-65A-12	0.1828	0.0	1695.0000	1303.0000	0.0	0.0119	0.0126	0.0	0.0126
29-65A-13	0.2026	0.0	1616.0000	1271.0000	0.0	0.0132	0.0139	0.0	0.0139
29-65A-14	0.2156	0.0	1467.0000	1238.0000	0.0	0.0144	0.0148	0.0	0.0148
29-65A-15	0.2183	0.0	1441.0000	1252.0000	0.0	0.0144	0.0150	0.0150	0.0
29-65A-16	0.2113	0.0	1446.0000	1237.0000	0.0	0.0140	0.0145	0.0145	0.0
29-65A-17	0.2039	0.0	1382.0000	1229.0000	0.0	0.0135	0.0140	0.0140	0.0
29-65A-18	0.2263	0.0	1327.0000	1193.0000	0.0	0.0148	0.0156	0.0156	0.0
29-65A-19	0.2589	0.0	1333.0000	1151.0000	0.0	0.0163	0.0178	0.0178	0.0
29-65A-20	0.1833	0.0	1386.0000	1207.0000	0.0	0.0126	0.0126	0.0126	0.0
29-65A-21	0.1984	0.0	1349.0000	1202.0000	0.0	0.0131	0.0136	0.0136	0.0
29-65A-22	0.1956	0.0	1441.0000	1088.0000	0.0	0.0134	0.0135	0.0135	0.0
29-65A-24	0.2239	0.0	1357.0000	1143.0000	0.0	0.0146	0.0154	0.0154	0.0
29-65A-25	0.2469	0.0	1361.0000	1079.0000	0.0	0.0166	0.0170	0.0170	0.0
29-65A-26	0.1868	0.0	1374.0000	1109.0000	0.0	0.0131	0.0128	0.0128	0.0
29-65A-26	0.2611	0.0	1374.0000	1109.0000	0.0	0.0167	0.0180	0.0180	0.0
29-65A-27	0.2331	0.0	1311.0000	1123.0000	0.0	0.0149	0.0160	0.0160	0.0
29-65A-28	0.1972	0.0	1298.0000	1121.0000	0.0	0.0131	0.0136	0.0136	0.0
29-65A-29	0.1841	0.0	1344.0000	1164.0000	0.0	0.0124	0.0127	0.0127	0.0
29-65A-30	0.1689	0.0	1457.0000	1234.0000	0.0	0.0111	0.0116	0.0116	0.0
29-65A-31	0.1996	0.0	1514.0000	1039.0000	0.0	0.0123	0.0137	0.0137	0.0
29-65A-32	0.2254	0.0	1462.0000	1053.0000	0.0	0.0139	0.0155	0.0155	0.0
29-65A-33	0.2440	0.0	1421.0000	1062.0000	0.0	0.0151	0.0168	0.0168	0.0
29-65A-34	0.1757	0.0	1518.0000	1025.0000	0.0	0.0115	0.0121	0.0121	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-65A-35	0.2902	1507.0000	0.0	0.0	0.0	0.0185	0.0200	0.0200	0.0
29-65A-36	0.2649	1428.0000	0.0	0.0	0.0	0.0171	0.0182	0.0182	0.0
29-65A-37	0.2291	1535.0000	0.0	0.0	0.0	0.0151	0.0158	0.0158	0.0
29-65A-38	0.1967	1900.0000	0.0	0.0	0.0	0.0132	0.0135	0.0135	0.0
29-65A-39	0.2173	1776.0000	0.0	0.0	0.0	0.0146	0.0150	0.0150	0.0
29-65A-40	0.2249	1882.0000	0.0	0.0	0.0	0.0144	0.0155	0.0155	0.0
29-65A-41	0.2411	1811.0000	0.0	0.0	0.0	0.0153	0.0166	0.0166	0.0
29-65A-42	0.2031	1855.0000	0.0	0.0	0.0	0.0135	0.0140	0.0140	0.0
29-65A-43	0.1892	1866.0000	0.0	0.0	0.0	0.0129	0.0130	0.0130	0.0
29-66A-1	0.3332	510.0000	1378.0000	1705.0000	0.0	0.0202	0.0229	0.0	0.0229
29-66A-2	0.3605	511.0000	1309.0000	1710.0000	0.0	0.0220	0.0248	0.0	0.0248
29-66A-3	0.3807	495.0000	1212.0000	1705.0000	0.0	0.0236	0.0262	0.0	0.0262
29-66A-4	0.4105	495.0000	1182.0000	1715.0000	0.0	0.0251	0.0282	0.0	0.0282
29-66A-5	0.3143	516.0000	1225.0000	1700.0000	0.0	0.0194	0.0216	0.0	0.0216
29-66A-6	0.2854	525.0000	1228.0000	1700.0000	0.0	0.0178	0.0196	0.0	0.0196
29-66A-7	0.2616	543.0000	1248.0000	1701.0000	0.0	0.0163	0.0180	0.0	0.0180
29-66A-8	0.2386	564.0000	1384.0000	1688.0000	0.0	0.0146	0.0164	0.0	0.0164
29-66A-9	0.3129	530.0000	1313.0000	1681.0000	0.0	0.0190	0.0215	0.0215	0.0
29-66A-10	0.3418	512.0000	1236.0000	1687.0000	0.0	0.0211	0.0235	0.0235	0.0
29-66A-11	0.3688	507.0000	1194.0000	1689.0000	0.0	0.0228	0.0254	0.0254	0.0
29-66A-12	0.3959	495.0000	1125.0000	1704.0000	0.0	0.0243	0.0272	0.0272	0.0
29-66A-13	0.2921	524.0000	1226.0000	1689.0000	0.0	0.0181	0.0201	0.0201	0.0
29-66A-14	0.2637	544.0000	1318.0000	1681.0000	0.0	0.0163	0.0181	0.0181	0.0
29-67A-1	0.2168	0.0	739.0000	1208.0000	0.0	0.0151	0.0149	0.0	0.0149
29-67A-2	0.1946	0.0	738.0000	1176.0000	0.0	0.0138	0.0134	0.0	0.0134
29-67A-3	0.1719	0.0	739.0000	1106.0000	0.0	0.0124	0.0118	0.0	0.0118
29-67A-4	0.1519	0.0	763.0000	1054.0000	0.0	0.0109	0.0105	0.0	0.0105
29-67A-5	0.1277	0.0	774.0000	989.0000	0.0	0.0094	0.0088	0.0	0.0088
29-67A-6	0.1027	0.0	712.0000	909.0000	0.0	0.0076	0.0071	0.0	0.0071
29-67A-7	0.1814	0.0	784.0000	1117.0000	0.0	0.0123	0.0125	0.0	0.0125
29-67A-8	0.1637	0.0	780.0000	1053.0000	0.0	0.0112	0.0113	0.0	0.0113
29-67A-9	0.1454	0.0	770.0000	993.0000	0.0	0.0101	0.0100	0.0	0.0100
29-67A-10	0.1256	0.0	758.0000	948.0000	0.0	0.0090	0.0086	0.0	0.0086
29-67A-11	0.1044	0.0	715.0000	899.0000	0.0	0.0077	0.0072	0.0	0.0072
29-67A-12	0.2066	0.0	789.0000	1191.0000	0.0	0.0127	0.0142	0.0142	0.0
29-67A-13	0.1801	0.0	830.0000	1148.0000	0.0	0.0114	0.0124	0.0124	0.0
29-67A-14	0.1517	0.0	795.0000	1026.0000	0.0	0.0100	0.0104	0.0104	0.0
29-67A-15	0.1268	0.0	772.0000	963.0000	0.0	0.0086	0.0087	0.0087	0.0
29-67A-16	0.1017	0.0	723.0000	890.0000	0.0	0.0071	0.0070	0.0070	0.0
29-67A-17	0.2115	0.0	1402.0000	1672.0000	0.0	0.0126	0.0146	0.0	0.0146
29-67A-18	0.1907	0.0	1407.0000	1036.0000	0.0	0.0112	0.0131	0.0	0.0131
29-67A-19	0.1676	0.0	1467.0000	1017.0000	0.0	0.0097	0.0115	0.0	0.0115
29-67A-20	0.1770	0.0	1449.0000	1028.0000	0.0	0.0102	0.0122	0.0	0.0122
29-67A-21	0.2317	0.0	1428.0000	1124.0000	0.0	0.0137	0.0159	0.0	0.0159
29-67A-22	0.2283	0.0	1469.0000	1187.0000	0.0	0.0143	0.0157	0.0157	0.0
29-67A-23	0.2047	0.0	1408.0000	1086.0000	0.0	0.0125	0.0141	0.0141	0.0
29-67A-24	0.1731	0.0	1382.0000	1039.0000	0.0	0.0110	0.0119	0.0119	0.0
29-67A-25	0.1452	0.0	1436.0000	998.0000	0.0	0.0093	0.0100	0.0100	0.0
29-67A-26	0.1619	0.0	1408.0000	1025.0000	0.0	0.0104	0.0111	0.0111	0.0
29-67A-27	0.2227	0.0	1429.0000	1276.0000	0.0	0.0157	0.0153	0.0	0.0153
29-67A-28	0.1986	0.0	1486.0000	1236.0000	0.0	0.0143	0.0137	0.0	0.0137

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-67A-29	0.1737	0.0	1505.0000	1157.0000	0.0	0.0125	0.0119	0.0	0.0119
29-67A-30	0.1492	0.0	1478.0000	1064.0000	0.0	0.0107	0.0103	0.0	0.0103
29-67A-31	0.1263	0.0	1439.0000	1011.0000	0.0	0.0095	0.0087	0.0	0.0087
29-68A-1	0.1704	851.0000	1474.0000	1253.0000	0.0	0.0097	0.0116	0.0	0.0116
29-68A-2	0.2221	937.0000	1667.0000	1386.0000	0.0	0.0131	0.0151	0.0	0.0151
29-68A-3	0.2810	1009.0000	1654.0000	1380.0000	0.0	0.0163	0.0191	0.0	0.0191
29-68A-4	0.3148	970.0000	1583.0000	1324.0000	0.0	0.0182	0.0214	0.0	0.0214
29-68A-5	0.3578	893.0000	1477.0000	1235.0000	0.0	0.0205	0.0243	0.0	0.0243
29-68A-6	0.3950	790.0000	1414.0000	1127.0000	0.0	0.0225	0.0269	0.0	0.0269
29-68A-7	0.2977	850.0000	1470.0000	1120.0000	0.0	0.0181	0.0205	0.0205	0.0
29-68A-8	0.3390	786.0000	1415.0000	1050.0000	0.0	0.0212	0.0233	0.0233	0.0
29-68A-9	0.3791	732.0000	1349.0000	996.0000	0.0	0.0228	0.0261	0.0261	0.0
29-68A-10	0.3184	752.0000	1339.0000	1136.0000	0.0	0.0196	0.0219	0.0219	0.0
29-69A-1	0.0772	693.0000	1135.0000	865.0000	0.0	0.0871	0.0856	0.0856	0.0
29-69A-2	0.1762	1733.0000	1292.0000	1181.0000	0.0	0.2129	0.1954	0.1954	0.0
29-69A-3	0.2629	1333.0000	1003.0000	968.0000	0.0	0.3095	0.2916	0.2916	0.0
29-69A-4	0.3650	799.0000	736.0000	709.0000	0.0	0.4799	0.4048	0.4048	0.0
29-69A-5	0.2295	1309.0000	1062.0000	1050.0000	0.0	0.2809	0.2545	0.2545	0.0
29-69A-6	0.2012	1202.0000	1200.0000	1107.0000	0.0	0.2363	0.2232	0.2232	0.0
29-69A-7	0.2642	1345.0000	987.0000	978.0000	0.0	0.3103	0.2930	0.2930	0.0
29-69A-8	0.1962	1641.0000	1198.0000	1121.0000	0.0	0.2345	0.2176	0.2176	0.0
29-69A-9	0.1732	556.0000	1081.0000	1070.0000	0.0	0.2028	0.1921	0.1921	0.0
29-69A-10	0.1790	594.0000	1134.0000	1098.0000	0.0	0.2159	0.1985	0.1985	0.0
29-69A-11	0.2093	653.0000	1129.0000	1106.0000	0.0	0.2637	0.2403	0.2403	0.0
29-69A-12	0.2616	662.0000	1058.0000	1051.0000	0.0	0.3129	0.2901	0.2901	0.0
29-69A-13	0.2370	591.0000	1016.0000	926.0000	0.0	0.3138	0.2704	0.2704	0.0
29-69A-14	0.2776	609.0000	963.0000	919.0000	0.0	0.3317	0.3078	0.3078	0.0
29-69A-15	0.2230	640.0000	1096.0000	1072.0000	0.0	0.2728	0.2563	0.2563	0.0
29-69A-16	0.1988	611.0000	1119.0000	1103.0000	0.0	0.2195	0.2204	0.2204	0.0
29-69A-17	0.1474	616.0000	1175.0000	1142.0000	0.0	0.1906	0.1696	0.1696	0.0
29-69A-18	0.2040	632.0000	1109.0000	1093.0000	0.0	0.2525	0.2348	0.2348	0.0
29-69A-19	0.2509	692.0000	1019.0000	1054.0000	0.0	0.3265	0.2895	0.2895	0.0
29-69A-20	0.2465	685.0000	1065.0000	1081.0000	0.0	0.2812	0.2734	0.2734	0.0
29-69A-21	0.1380	691.0000	1247.0000	0.0	0.0	0.2963	0.1945	0.1945	0.0
29-69A-22	0.1315	695.0000	1276.0000	0.0	0.0	0.2694	0.1864	0.1864	0.0
29-69A-23	0.1289	718.0000	1282.0000	0.0	0.0	0.2862	0.1879	0.1879	0.0
29-69A-24	0.1334	709.0000	1256.0000	0.0	0.0	0.2985	0.1908	0.1908	0.0
29-69A-25	0.2164	687.0000	1101.0000	0.0	0.0	0.4924	0.3063	0.3063	0.0
29-69A-26	0.1694	682.0000	1206.0000	0.0	0.0	0.3393	0.2400	0.2400	0.0
29-69A-27	0.1825	678.0000	1219.0000	0.0	0.0	0.2328	0.2131	0.2131	0.0
29-69A-28	0.2261	699.0000	1182.0000	0.0	0.0	0.2700	0.2618	0.2618	0.0
29-69A-29	0.1226	708.0000	1337.0000	0.0	0.0	0.2410	0.1796	0.1796	0.0
29-70A-1	0.2429	1021.0000	926.0000	901.0000	774.0000	0.0153	0.0167	0.0167	0.0
29-70A-2	0.2027	949.0000	865.0000	842.0000	746.0000	0.0131	0.0139	0.0139	0.0
29-70A-3	0.1766	912.0000	851.0000	813.0000	726.0000	0.0117	0.0121	0.0121	0.0
29-70A-4	0.2878	1121.0000	1001.0000	963.0000	803.0000	0.0176	0.0198	0.0198	0.0
29-70A-5	0.3175	1150.0000	1056.0000	1023.0000	827.0000	0.0197	0.0218	0.0218	0.0
29-70A-6	0.3728	1169.0000	1137.0000	1107.0000	866.0000	0.0234	0.0256	0.0256	0.0
29-70A-7	0.4311	1155.0000	1160.0000	1143.0000	889.0000	0.0270	0.0297	0.0297	0.0
29-71A-1	0.2331	1276.0000	1760.0000	1694.0000	0.0	0.0149	0.0160	0.0	0.0160
29-71A-2	0.2122	1278.0000	1699.0000	1687.0000	0.0	0.0147	0.0146	0.0	0.0146

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-71A-3	0.1886	1240.0000	1662.0000	1640.0000	0.0	0.0133	0.0130	0.0	0.0130
29-71A-4	0.1587	1136.0000	1569.0000	1549.0000	0.0	0.0109	0.0109	0.0	0.0109
29-71A-5	0.1269	1068.0000	1512.0000	1560.0000	0.0	0.0090	0.0087	0.0	0.0087
29-71A-6	0.2386	1241.0000	1720.0000	1680.0000	0.0	0.0167	0.0164	0.0	0.0164
29-71A-7	0.2574	1284.0000	1780.0000	1660.0000	0.0	0.0171	0.0177	0.0177	0.0
29-71A-8	0.2284	1267.0000	1705.0000	1654.0000	0.0	0.0158	0.0157	0.0157	0.0
29-71A-9	0.1972	1240.0000	1674.0000	1644.0000	0.0	0.0138	0.0136	0.0136	0.0
29-71A-10	0.1646	1179.0000	1578.0000	1591.0000	0.0	0.0118	0.0113	0.0113	0.0
29-71A-11	0.1355	1190.0000	1547.0000	1577.0000	0.0	0.0102	0.0093	0.0093	0.0
29-71A-12	0.1078	1069.0000	1475.0000	1445.0000	0.0	0.0082	0.0074	0.0074	0.0
29-71A-13	0.1046	1013.0000	1472.0000	1395.0000	0.0	0.0075	0.0072	0.0	0.0072
29-71A-14	0.1319	1091.0000	1452.0000	1520.0000	0.0	0.0091	0.0091	0.0	0.0091
29-71A-15	0.1593	1201.0000	1508.0000	1622.0000	0.0	0.0108	0.0110	0.0	0.0110
29-71A-16	0.1856	1203.0000	1511.0000	1663.0000	0.0	0.0126	0.0128	0.0	0.0128
29-71A-17	0.2462	1036.0000	1750.0000	1560.0000	0.0	0.0160	0.0169	0.0	0.0169
29-71A-18	0.2207	1012.0000	1700.0000	1551.0000	0.0	0.0143	0.0152	0.0	0.0152
29-71A-19	0.1949	1060.0000	1716.0000	1592.0000	0.0	0.0128	0.0134	0.0	0.0134
29-71A-20	0.1689	1117.0000	1739.0000	1652.0000	0.0	0.0112	0.0116	0.0	0.0116
29-71A-21	0.1434	1172.0000	1741.0000	1654.0000	0.0	0.0097	0.0099	0.0	0.0099
29-71A-22	0.2640	1101.0000	1665.0000	1602.0000	0.0	0.0171	0.0182	0.0182	0.0
29-71A-23	0.2407	1042.0000	1648.0000	1550.0000	0.0	0.0153	0.0166	0.0166	0.0
29-71A-24	0.2081	1035.0000	1727.0000	1519.0000	0.0	0.0134	0.0143	0.0143	0.0
29-71A-25	0.1748	1056.0000	1737.0000	1500.0000	0.0	0.0121	0.0120	0.0120	0.0
29-71A-26	0.2130	1217.0000	1197.0000	1471.0000	0.0	0.0136	0.0147	0.0147	0.0
29-71A-27	0.1860	1202.0000	1258.0000	1506.0000	0.0	0.0124	0.0128	0.0128	0.0
29-71A-28	0.1569	1283.0000	1294.0000	1555.0000	0.0	0.0108	0.0108	0.0108	0.0
29-71A-29	0.1351	1286.0000	1312.0000	1618.0000	0.0	0.0093	0.0093	0.0093	0.0
29-71A-30	0.1086	1229.0000	1278.0000	1613.0000	0.0	0.0078	0.0075	0.0075	0.0
29-71A-31	0.1718	1292.0000	1224.0000	1537.0000	0.0	0.0115	0.0118	0.0118	0.0
29-71A-32	0.2016	1297.0000	1150.0000	1481.0000	0.0	0.0130	0.0139	0.0139	0.0
29-71A-33	0.1787	1287.0000	1175.0000	1494.0000	0.0	0.0116	0.0123	0.0123	0.0
29-71A-34	0.0990	1180.0000	1084.0000	1301.0000	0.0	0.0067	0.0068	0.0068	0.0
29-71A-35	0.0805	1184.0000	1158.0000	1565.0000	0.0	0.0052	0.0055	0.0055	0.0
29-71A-36	0.0999	1188.0000	1142.0000	1608.0000	0.0	0.0067	0.0069	0.0069	0.0
29-71A-37	0.1017	1150.0000	1130.0000	1602.0000	0.0	0.0068	0.0070	0.0070	0.0
29-71A-38	0.1193	1185.0000	1132.0000	1561.0000	0.0	0.0079	0.0082	0.0082	0.0
29-71A-39	0.1082	1166.0000	1100.0000	1577.0000	0.0	0.0074	0.0074	0.0074	0.0
29-71A-40	0.1140	1190.0000	1130.0000	1572.0000	0.0	0.0081	0.0078	0.0078	0.0
29-71A-41	0.1726	836.0000	1723.0000	1489.0000	0.0	0.0122	0.0119	0.0	0.0119
29-71A-43	0.2016	887.0000	1744.0000	1484.0000	0.0	0.0142	0.0139	0.0	0.0139
29-71A-44	0.2346	924.0000	1786.0000	1466.0000	0.0	0.0161	0.0161	0.0	0.0161
29-71A-45	0.2659	960.0000	1784.0000	1435.0000	0.0	0.0177	0.0183	0.0	0.0183
29-71A-46	0.2916	942.0000	1715.0000	1392.0000	0.0	0.0195	0.0201	0.0	0.0201
29-71A-47	0.3276	929.0000	1685.0000	1342.0000	0.0	0.0214	0.0225	0.0	0.0225
29-71A-48	0.3558	918.0000	1606.0000	1305.0000	0.0	0.0232	0.0245	0.0	0.0245
29-71A-49	0.1784	900.0000	1709.0000	1499.0000	0.0	0.0131	0.0123	0.0123	0.0
29-71A-50	0.2120	911.0000	1733.0000	1472.0000	0.0	0.0151	0.0146	0.0146	0.0
29-71A-51	0.2494	947.0000	1755.0000	1432.0000	0.0	0.0171	0.0172	0.0172	0.0
29-71A-52	0.2969	956.0000	1711.0000	1370.0000	0.0	0.0184	0.0204	0.0204	0.0
29-71A-53	0.3212	903.0000	1588.0000	1302.0000	0.0	0.0205	0.0221	0.0221	0.0
29-71A-54	0.2951	907.0000	1639.0000	1286.0000	0.0	0.0192	0.0203	0.0203	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
2035	29-72A-1	0.3564	1004.0000	759.0000	869.0000	0.0	0.0233	0.0245	0.0	0.0245
2036	29-72A-2	0.2875	1059.0000	766.0000	853.0000	0.0	0.0181	0.0198	0.0	0.0198
2037	29-72A-3	0.2564	1034.0000	738.0000	809.0000	0.0	0.0160	0.0176	0.0	0.0176
2038	29-72A-4	0.2179	1158.0000	686.0000	779.0000	0.0	0.0144	0.0150	0.0	0.0150
2039	29-72A-5	0.1891	1124.0000	728.0000	839.0000	0.0	0.0128	0.0130	0.0	0.0130
2040	29-72A-6	0.1571	1127.0000	734.0000	961.0000	0.0	0.0109	0.0108	0.0	0.0108
2041	29-72A-7	0.1227	1102.0000	762.0000	991.0000	0.0	0.0090	0.0084	0.0	0.0084
2042	29-72A-8	0.0934	1129.0000	799.0000	1085.0000	0.0	0.0071	0.0064	0.0	0.0064
2043	29-72A-9	0.2694	944.0000	727.0000	951.0000	0.0	0.0160	0.0185	0.0185	0.0
2044	29-72A-10	0.2307	974.0000	708.0000	878.0000	0.0	0.0146	0.0159	0.0159	0.0
2045	29-72A-11	0.1886	1045.0000	686.0000	875.0000	0.0	0.0130	0.0130	0.0130	0.0
2046	29-72A-12	0.1543	1183.0000	693.0000	925.0000	0.0	0.0108	0.0106	0.0106	0.0
2047	29-72A-13	0.1145	1131.0000	771.0000	1266.0000	0.0	0.0088	0.0079	0.0079	0.0
2048	29-72A-14	0.0834	1111.0000	800.0000	1313.0000	0.0	0.0067	0.0057	0.0057	0.0
2049	29-72A-15	0.0988	1288.0000	815.0000	1369.0000	0.0	0.0078	0.0068	0.0068	0.0
2077	29-73A-1	0.0656	713.0000	702.0000	1237.0000	687.0000	0.0	0.0045	0.0	0.0045
2078	29-73A-2	0.0808	701.0000	700.0000	1109.0000	880.0000	0.0	0.0056	0.0	0.0056
2079	29-73A-3	0.0504	702.0000	693.0000	1158.0000	840.0000	0.0	0.0035	0.0	0.0035
2080	29-73A-4	0.0359	679.0000	671.0000	850.0000	783.0000	0.0	0.0025	0.0	0.0025
2081	29-73A-5	0.0488	732.0000	738.0000	911.0000	873.0000	0.0	0.0034	0.0	0.0034
2082	29-73A-6	0.0636	669.0000	731.0000	1065.0000	893.0000	0.0	0.0044	0.0	0.0044
2084	29-73A-7	0.0820	0.0	1745.0000	1633.0000	1653.0000	0.0057	0.0056	0.0	0.0056
2085	29-73A-8	0.0701	0.0	1589.0000	1618.0000	1689.0000	0.0049	0.0048	0.0	0.0048
2086	29-73A-9	0.0906	0.0	1747.0000	1660.0000	1704.0000	0.0060	0.0062	0.0	0.0062
2087	29-73A-10	0.1029	0.0	1721.0000	1638.0000	1680.0000	0.0068	0.0071	0.0	0.0071
2088	29-73A-11	0.0466	0.0	1409.0000	1470.0000	1588.0000	0.0036	0.0032	0.0	0.0032
2089	29-73A-12	0.0531	0.0	1508.0000	1551.0000	1678.0000	0.0036	0.0037	0.0	0.0037
2090	29-73A-13	0.0677	0.0	1629.0000	1604.0000	1659.0000	0.0045	0.0047	0.0	0.0047
2091	29-73A-14	0.0793	0.0	1670.0000	1567.0000	1571.0000	0.0051	0.0055	0.0	0.0055
2092	29-73A-15	0.0875	0.0	1653.0000	1550.0000	1569.0000	0.0057	0.0060	0.0	0.0060
2093	29-73A-16	0.0929	0.0	1615.0000	1490.0000	1606.0000	0.0060	0.0064	0.0	0.0064
2094	29-73A-17	0.0695	0.0	1631.0000	1541.0000	1584.0000	0.0046	0.0048	0.0	0.0048
2095	29-73A-18	0.0801	0.0	1683.0000	1460.0000	1544.0000	0.0053	0.0055	0.0	0.0055
2096	29-73A-19	0.0873	0.0	1680.0000	1549.0000	1505.0000	0.0056	0.0060	0.0	0.0060
2097	29-73A-20	0.0927	0.0	1653.0000	1493.0000	1555.0000	0.0061	0.0064	0.0	0.0064
2098	29-73A-21	0.0918	0.0	1900.0000	1790.0000	1780.0000	0.0060	0.0063	0.0	0.0063
2099	29-73A-22	0.1130	0.0	1761.0000	1704.0000	1692.0000	0.0073	0.0078	0.0	0.0078
2100	29-73A-23	0.0755	0.0	1920.0000	1838.0000	1792.0000	0.0052	0.0052	0.0	0.0052
2116	29-74A-1	0.1708	837.0000	1340.0000	1465.0000	0.0	0.0116	0.0117	0.0	0.0117
2117	29-74A-2	0.2029	865.0000	1405.0000	1535.0000	0.0	0.0129	0.0140	0.0	0.0140
2118	29-74A-3	0.2316	904.0000	1501.0000	1520.0000	0.0	0.0149	0.0159	0.0	0.0159
2119	29-74A-4	0.2609	913.0000	1470.0000	1473.0000	0.0	0.0169	0.0180	0.0	0.0180
2120	29-74A-5	0.2910	933.0000	1430.0000	1420.0000	0.0	0.0190	0.0200	0.0	0.0200
2121	29-74A-6	0.3219	961.0000	1387.0000	1330.0000	0.0	0.0208	0.0221	0.0	0.0221
2122	29-74A-7	0.3498	858.0000	1357.0000	1270.0000	0.0	0.0226	0.0241	0.0	0.0241
2123	29-74A-8	0.1763	881.0000	1369.0000	1454.0000	0.0	0.0121	0.0121	0.0121	0.0
2124	29-74A-9	0.2104	905.0000	1361.0000	1467.0000	0.0	0.0136	0.0145	0.0145	0.0
2125	29-74A-10	0.2481	922.0000	1381.0000	1437.0000	0.0	0.0161	0.0171	0.0171	0.0
2126	29-74A-11	0.2852	925.0000	1309.0000	1390.0000	0.0	0.0179	0.0196	0.0196	0.0
2127	29-74A-12	0.3180	893.0000	1288.0000	1336.0000	0.0	0.0187	0.0219	0.0219	0.0
2128	29-74A-13	0.3455	861.0000	1211.0000	1266.0000	0.0	0.0216	0.0238	0.0238	0.0

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

	SCHEME	EGR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
2130	29-75A-1	0.1974	833.0000	1269.0000	1633.0000	0.0	0.0115	0.0136	0.0	0.0136
2131	29-75A-2	0.2313	868.0000	1353.0000	1659.0000	0.0	0.0135	0.0159	0.0	0.0159
2132	29-75A-3	0.2613	872.0000	1434.0000	1655.0000	0.0	0.0154	0.0180	0.0	0.0180
2133	29-75A-4	0.3030	880.0000	1502.0000	1643.0000	0.0	0.0175	0.0208	0.0	0.0208
2134	29-75A-5	0.3350	916.0000	1582.0000	1614.0000	0.0	0.0194	0.0230	0.0	0.0230
2135	29-75A-6	0.3760	917.0000	1619.0000	1522.0000	0.0	0.0212	0.0259	0.0	0.0259
2136	29-75A-7	0.4138	880.0000	1479.0000	1368.0000	0.0	0.0232	0.0285	0.0	0.0285
2137	29-75A-8	0.2068	857.0000	1403.0000	1572.0000	0.0	0.0121	0.0142	0.0142	0.0
2138	29-75A-9	0.2463	940.0000	1416.0000	1594.0000	0.0	0.0142	0.0169	0.0169	0.0
2139	29-75A-10	0.2876	972.0000	1433.0000	1584.0000	0.0	0.0160	0.0198	0.0198	0.0
2140	29-75A-11	0.3264	918.0000	1337.0000	1446.0000	0.0	0.0174	0.0226	0.0226	0.0
2141	29-75A-12	0.2662	858.0000	1469.0000	1353.0000	0.0	0.0150	0.0183	0.0183	0.0
2142	29-75A-13	0.2298	938.0000	1478.0000	1376.0000	0.0	0.0133	0.0158	0.0158	0.0
2143	29-75A-14	0.1645	928.0000	1432.0000	1588.0000	0.0	0.0113	0.0113	0.0113	0.0
2145	29-76A-1	0.0952	0.0	0.0	1570.0000	1509.0000	0.0064	0.0065	0.0	0.0065
2146	29-76A-2	0.0838	0.0	0.0	1652.0000	1541.0000	0.0057	0.0058	0.0	0.0058
2147	29-76A-3	0.0724	0.0	0.0	1652.0000	1550.0000	0.0050	0.0050	0.0	0.0050
2148	29-76A-4	0.0541	0.0	0.0	1619.0000	1694.0000	0.0041	0.0037	0.0	0.0037
2149	29-76A-5	0.0548	0.0	0.0	1621.0000	1652.0000	0.0039	0.0038	0.0	0.0038
2150	29-76A-6	0.0696	0.0	0.0	1650.0000	1554.0000	0.0048	0.0048	0.0	0.0048
2151	29-76A-7	0.0852	0.0	0.0	1682.0000	1550.0000	0.0059	0.0059	0.0	0.0059
2152	29-76A-8	0.0747	0.0	0.0	1560.0000	1357.0000	0.0046	0.0051	0.0	0.0051
2153	29-76A-9	0.0647	0.0	0.0	1543.0000	1587.0000	0.0042	0.0045	0.0	0.0045
2154	29-76A-10	0.0515	0.0	0.0	1494.0000	1597.0000	0.0037	0.0035	0.0	0.0035
2155	29-76A-11	0.0442	0.0	0.0	1404.0000	1496.0000	0.0032	0.0030	0.0	0.0030
2156	29-76A-12	0.0515	0.0	0.0	1450.0000	1553.0000	0.0036	0.0035	0.0	0.0035
2157	29-76A-13	0.0629	0.0	0.0	1494.0000	1546.0000	0.0042	0.0043	0.0	0.0043
2158	29-76A-14	0.0702	0.0	0.0	1471.0000	1508.0000	0.0045	0.0048	0.0	0.0048
2159	29-76A-15	0.0359	0.0	0.0	1204.0000	1259.0000	0.0029	0.0025	0.0	0.0025
2160	29-76A-16	0.0493	0.0	0.0	1275.0000	1336.0000	0.0034	0.0034	0.0	0.0034
2161	29-76A-17	0.0599	0.0	0.0	1305.0000	1328.0000	0.0039	0.0041	0.0	0.0041
2162	29-76A-18	0.0669	0.0	0.0	1091.0000	1123.0000	0.0043	0.0046	0.0	0.0046
2164	29-77A-1	0.1394	623.0000	1365.0000	1231.0000	0.0	0.0104	0.0096	0.0	0.0096
2165	29-77A-2	0.1718	638.0000	1420.0000	1347.0000	0.0	0.0123	0.0118	0.0	0.0118
2166	29-77A-3	0.2354	677.0000	1546.0000	1564.0000	0.0	0.0166	0.0162	0.0	0.0162
2167	29-77A-4	0.2948	669.0000	1654.0000	1722.0000	0.0	0.0205	0.0203	0.0	0.0203
2168	29-77A-5	0.3545	636.0000	1671.0000	1668.0000	0.0	0.0240	0.0244	0.0	0.0244
2169	29-77A-6	0.4149	616.0000	1613.0000	1596.0000	0.0	0.0283	0.0285	0.0	0.0285
2170	29-77A-7	0.4453	601.0000	1577.0000	1534.0000	0.0	0.0307	0.0306	0.0	0.0306
2171	29-77A-8	0.4746	580.0000	1548.0000	1469.0000	0.0	0.0327	0.0327	0.0	0.0327
2172	29-77A-9	0.5054	568.0000	1519.0000	1385.0000	0.0	0.0361	0.0348	0.0	0.0348
2173	29-77A-10	0.3504	647.0000	1664.0000	1658.0000	0.0	0.0229	0.0241	0.0241	0.0
2174	29-77A-11	0.4084	618.0000	1614.0000	1543.0000	0.0	0.0276	0.0281	0.0281	0.0
2175	29-77A-12	0.4355	612.0000	1587.0000	1467.0000	0.0	0.0298	0.0300	0.0300	0.0
2176	29-77A-13	0.4658	600.0000	1551.0000	1322.0000	0.0	0.0315	0.0321	0.0321	0.0
2177	29-77A-14	0.4454	594.0000	1563.0000	1311.0000	0.0	0.0300	0.0306	0.0306	0.0
2178	29-77A-15	0.5404	564.0000	1455.0000	1208.0000	0.0	0.0383	0.0372	0.0372	0.0
2180	29-77A-16	0.2973	535.0000	1514.0000	1489.0000	0.0	0.0217	0.0205	0.0	0.0205
2181	29-77A-17	0.3355	518.0000	1662.0000	1596.0000	0.0	0.0245	0.0231	0.0	0.0231
2182	29-77A-18	0.2307	621.0000	1610.0000	1655.0000	0.0	0.0146	0.0159	0.0	0.0159
2183	29-77A-19	0.2790	584.0000	1564.0000	1558.0000	0.0	0.0188	0.0192	0.0	0.0192

TABLE A-3
COMBUSTOR LINER TEMPERATURE DATA AND FUEL AIR RATIO INFORMATION (Continued)

SCHEME	EQR	BST1	BST2	BST3	BST4	FASAM	FUAIR	FAOX1	FAOX2
29-77A-20	0.3017	563.0000	1510.0000	1514.0000	0.0	0.0205	0.0208	0.0	0.0206
29-77A-21	0.3243	549.0000	1483.0000	1464.0000	0.0	0.0229	0.0223	0.0	0.0223
29-77A-22	0.3474	525.0000	1536.0000	1402.0000	0.0	0.0249	0.0239	0.0	0.0239
29-77A-23	0.3131	530.0000	1564.0000	1524.0000	0.0	0.0221	0.0215	0.0	0.0215
29-77A-24	0.2084	627.0000	1584.0000	1633.0000	0.0	0.0134	0.0143	0.0	0.0143
29-77A-25	0.1606	637.0000	1451.0000	1380.0000	0.0	0.0105	0.0111	0.0	0.0111
29-77A-26	0.1099	619.0000	1234.0000	1122.0000	0.0	0.0078	0.0076	0.0	0.0076
29-77A-27	0.3975	532.0000	1436.0000	1445.0000	0.0	0.0288	0.0273	0.0	0.0273
29-77A-28	0.4224	516.0000	1201.0000	1361.0000	0.0	0.0302	0.0291	0.0	0.0291
29-77A-29	0.3741	505.0000	1238.0000	1312.0000	0.0	0.0268	0.0257	0.0	0.0257
29-77A-30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29-77A-31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29-77A-32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29-77A-33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE A-4. SPECIAL PARAMETERS — HEAT EXCHANGER INFORMATION

Scheme	*WH20*	*TBCI*	*TBCO*	*HEAT*	*FTHR*
5-14A-1	2671.0000	84.0000	117.0000	24.4842	0.0894
5-14A-2	2677.0000	84.0000	116.0000	23.7956	0.0738
5-14A-3	2672.0000	84.0000	110.0000	19.2978	0.0494
5-14A-4	2736.0000	84.0000	108.0000	18.2400	0.0394
5-14A-5	1688.0000	84.0000	120.0000	16.8800	0.0337
5-14A-6	2714.0000	85.0000	108.0000	17.3394	0.0327
5-14A-7	2714.0000	86.0000	108.0000	16.5855	0.0277
5-14A-8	2708.0000	85.0000	106.0000	15.7967	0.0247
5-14A-9	2713.0000	84.0000	105.0000	15.8258	0.0208
5-14A-10	3040.0000	85.0000	121.0000	30.4000	0.1397
5-14A-11	3041.0000	85.0000	118.0000	27.8758	0.0921
5-14A-12	3042.0000	85.0000	114.0000	24.5050	0.0684
5-14A-13	3032.0000	86.0000	114.0000	23.5822	0.0539
5-14A-14	3034.0000	85.0000	113.0000	23.5978	0.0459
5-14A-15	3031.0000	86.0000	113.0000	22.7325	0.0383
5-14A-16	3029.0000	86.0000	113.0000	22.7175	0.0329
5-15A-1	2700.0000	85.0000	119.0000	25.5000	0.0972
5-15A-2	2701.0000	86.0000	122.0000	27.0100	0.0812
5-15A-3	2705.0000	86.0000	126.0000	30.0555	0.0773
5-15A-4	2712.0000	86.0000	130.0000	33.1467	0.0695
5-15A-5	2711.0000	86.0000	132.0000	34.6405	0.0625
5-15A-6	2711.0000	86.0000	132.0000	34.6405	0.0536
5-15A-7	2709.0000	86.0000	132.0000	34.6150	0.0451
5-15A-8	2715.0000	86.0000	132.0000	34.6917	0.0503
5-15A-9	2702.0000	87.0000	126.0000	29.2717	0.1367
5-15A-10	2702.0000	87.0000	132.0000	33.7750	0.1116
5-15A-11	2703.0000	87.0000	135.0000	36.0400	0.1008
5-15A-12	2700.0000	87.0000	138.0000	38.2500	0.0896
5-15A-13	2704.0000	87.0000	140.0000	39.8089	0.0783
5-15A-14	2701.0000	87.0000	142.0000	41.2653	0.0703
5-15A-15	2700.0000	87.0000	142.0000	41.2500	0.0606
5-15A-16	2706.0000	87.0000	142.0000	41.3417	0.0649
5-17A-1	4815.0000	74.0000	110.0000	48.1500	0.3874
5-17A-2	4081.0000	79.0000	119.0000	45.3444	0.3345
5-17A-3	4794.0000	78.0000	120.0000	55.9300	0.2238
5-17A-4	5550.0000	77.0000	120.0000	66.2917	0.1765
5-17A-5	5880.0000	76.0000	122.0000	75.1333	0.1517
5-17A-6	5280.0000	75.0000	126.0000	74.8000	0.1194
5-17A-7	6422.0000	76.0000	119.0000	76.7072	0.1566
5-17A-8	7137.0000	76.0000	117.0000	81.2825	0.1321
5-17A-9	6002.0000	77.0000	123.0000	76.6922	0.1549
5-18A-1	5105.0000	75.0000	106.0000	43.9597	0.2747
5-18A-2	3924.0000	78.0000	122.0000	47.9600	0.3122
5-18A-3	4413.0000	78.0000	124.0000	56.3883	0.2098
5-18A-4	4901.0000	77.0000	124.0000	63.9853	0.1630
5-18A-5	4997.0000	77.0000	121.0000	61.0744	0.1194
5-18A-6	4982.0000	77.0000	121.0000	60.8911	0.0971
5-18A-7	5007.0000	78.0000	121.0000	59.8058	0.0874
5-18A-8	4107.0000	81.0000	130.0000	55.9008	1.2068
5-18A-9	4878.0000	76.0000	130.0000	73.1700	0.2454

TABLE A-4. SPECIAL PARAMETERS — HEAT EXCHANGER INFORMATION (Continued)

Scheme	*WH20*	*TBCI*	*TBCO*	*HEAT*	*FTHR*
5-18A-10	4827.0000	76.0000	144.0000	91.1767	0.1200
5-19A-1	5820.0000	65.0000	81.0000	25.8667	0.0
5-19B-1	6905.0000	65.0000	84.0000	36.4431	0.1374
5-19B-2	6911.0000	66.0000	87.0000	40.3142	0.0785
5-19B-3	6900.0000	66.0000	88.0000	42.1667	0.0614
5-19B-4	7111.0000	65.0000	98.0000	65.1842	0.1756
5-19B-5	7193.0000	65.0000	95.0000	59.9417	0.0894
5-19B-6	7294.0000	66.0000	95.0000	58.7572	0.0904
5-19B-7	7202.0000	66.0000	102.0000	72.0200	0.0934
5-19B-8	7008.0000	67.0000	108.9000	79.8133	0.0760
5-20A-1	2528.0000	80.0000	105.0000	17.5555	0.1120
5-20A-2	2294.0000	80.0000	105.0000	15.9306	0.0799
5-20A-3	2296.0000	79.0000	110.0000	19.7711	0.0771
5-20A-4	2256.0000	80.0000	119.0000	24.4400	0.0615
5-21A-1	4852.0000	82.0000	105.0000	30.9989	0.1275
5-21A-2	5037.0000	83.0000	105.0000	30.7817	0.1173
5-21A-3	5005.0000	82.0000	105.0000	31.9764	0.1537
5-21A-4	5091.0000	82.0000	105.0000	32.5258	0.1911
5-21A-5	5051.0000	82.0000	105.0000	32.2703	0.2661
5-22A-1	8385.0000	79.0000	100.0000	48.9125	0.1206
5-22A-2	8373.0000	79.0000	103.0000	55.8200	0.1070
5-22A-3	8350.0000	78.0000	103.0000	57.9861	0.0939
5-22A-4	8366.0000	79.0000	101.0000	51.1255	0.0714
5-22A-5	8355.0000	79.0000	101.0000	51.0583	0.1739
5-23A-1	8571.0000	82.0000	87.0000	11.9042	0.1739
5-23A-2	8033.0000	82.0000	90.0000	17.8511	0.1739
5-23B-1	2243.0000	77.0000	105.0000	17.4455	0.0415
5-23B-2	7230.0000	79.0000	105.0000	52.2167	0.0936
5-23B-3	7238.0000	79.0000	103.0000	48.2533	0.0669
5-23B-4	7238.0000	79.0000	103.0000	48.2533	0.1616
5-23B-5	7235.0000	76.0000	101.0000	50.2430	0.2626
5-23B-6	7216.0000	76.0000	101.0000	50.1111	0.2040
5-23B-7	7205.0000	76.0000	103.0000	54.0375	0.1538
5-23B-8	7715.0000	78.0000	110.0000	68.5778	0.2218
5-23B-9	7456.0000	78.0000	119.0000	84.9155	0.1665
5-23B-10	7482.0000	80.0000	120.0000	83.1333	0.1244
5-23B-11	7450.0000	91.0000	122.0000	64.1528	0.0771
5-23B-12	9127.0000	80.0000	101.0000	53.2408	0.1327
5-23B-13	9101.0000	81.0000	101.0000	50.5611	0.1652
5-23B-14	9116.0000	80.0000	99.0000	48.1122	0.2425
5-23B-15	9105.0000	82.0000	99.0000	42.9958	0.0514
5-23B-16	9068.0000	80.0000	100.0000	50.3778	0.0852
5-23B-17	9141.0000	80.0000	101.0000	53.3225	0.1041
5-23B-18	9123.0000	80.0000	101.0000	53.2175	0.0792
5-23B-19	9114.0000	80.0000	101.0000	53.1650	0.0707
5-23B-20	9097.0000	79.0000	100.0000	53.0658	0.1263
5-23B-21	7693.0000	76.0000	116.0000	85.4778	0.1896
5-23B-22	7633.0000	76.0000	121.0000	95.4125	0.1668

TABLE A-4
SPECIAL PARAMETERS — HEAT EXCHANGER INFORMATION
(Continued)

Scheme	*TIN1*	*WHXA*	*TOUT*
5-24A-1	580.0000	26.1000	
5-24A-2	634.0000	26.1000	
5-24A-3	643.0000	26.1000	
5-25A-1	625.0000	27.9000	
5-25A-2	627.0000	27.9000	
5-25A-3	639.0000	27.9000	
5-25A-4	640.0000	27.9000	
5-25A-5	647.0000	27.9000	
5-25A-6	647.0000	27.9000	
5-25A-7	642.0000	27.9000	
5-25A-8	632.0000	27.9000	
5-25A-9	624.0000	27.9000	
5-25A-10	645.0000	27.9000	
5-26A-1	594.0000	21.2000	789.0000
5-26A-2	592.0000	21.2000	834.0000
5-26A-3	593.0000	21.2000	904.0000

PARAMETERS

WH20 — Heat exchanger water flow rate (pph)
T8CI — Heat exchanger water inlet temperature (°F)
T5CO — Heat exchanger water exit temperature (°F)
HEAT — Heat rate removed from combustor and gained by heat exchanger water (Btu/sec)
FTHR — Heat removed from combustor by heat exchanger as a fraction of total heat released
TIN1 — Cooling air temperature entering heat exchanger tubes (°F)
WHXA — Heat exchanger airflow (% of total airflow)
TOUT — Cooling air temperature exiting heat exchanger tubes (°F)

TABLE A-5
SPECIAL PARAMETERS — PRESSURE DROP AND AIRFLOW RATE DATA

Scheme	*WBOOST*	*DPMAN*
14-1A-1	0.7291	58.00
14-1A-2	0.7288	53.00
14-1A-3	0.7299	48.00
14-2A-1	0.7594	25.00
14-2A-2	0.7597	25.00
14-2A-3	0.7620	25.00
14-2A-4	0.7637	25.00
14-2A-5	0.7708	25.00
14-2A-6	0.5636	13.50
14-2A-7	0.5641	13.50
14-2A-8	0.5646	13.50

Scheme	*WAPRI*
29-9A-1	0.125
29-9A-2	0.120
29-9A-3	0.120
29-9A-4	0.118
29-9A-5	0.119
29-9A-6	0.199
29-9A-7	0.219
29-9A-8	0.218
29-9A-9	0.218
29-9A-10	0.219
29-9A-11	0.219
29-9A-12	0.219
29-9A-13	0.220
29-9A-14	0.219
29-9A-15	0.222
29-9A-16	0.223
29-9A-17	0.223
29-9A-18	0.223
29-9A-19	0.222
29-9A-20	0.272
29-9A-21	0.274
29-9A-22	0.275
29-9A-23	0.273
29-9A-24	0.275
29-10A-1	0.116
29-10A-2	0.117
29-10A-3	0.116
29-10A-4	0.116
29-10A-5	0.116
29-10A-6	0.113
29-10A-7	0.113
29-10A-8	0.113
29-10A-9	0.112
29-10A-10	0.112

TABLE A-5
SPECIAL PARAMETERS — PRESSURE DROP AND AIRFLOW RATE DATA (Continued)

Scheme	*WAPRI*
29-10A-11	0.110
29-10A-12	0.109
29-10A-13	0.109
29-10A-14	0.110
29-10A-15	0.109
29-10A-16	0.210
29-10A-17	0.211
29-10A-18	0.209
29-10A-19	0.212
29-10A-20	0.210
29-10A-21	0.210
29-10A-22	0.209
29-10A-23	0.211
29-10A-24	0.210
29-10A-25	0.427
29-10A-26	0.423
29-10A-27	0.291
29-10A-28	0.216
29-10A-29	0.310
29-10A-30	0.228
29-11A-1	0.138
29-11B-1	0.315
29-11B-2	0.376
29-12-1	0.404
29-12-2	0.417
29-12-3	0.414
29-12-4	0.413
29-12-5	0.421
29-12-6	0.416
29-12-7	0.417
29-12-8	0.402
29-12-9	0.402
29-12-10	0.536

PARAMETERS
WBOOST — Boost Dilution Airflow Rate (pps)
DPMAN — Boost Dilution Airflow Pressure Drop (psid)
WAPRI — Primary Zone Airflow Passing Through Premix Tube (pps)

TABLE A-6
SPECIAL PARAMETERS — LOW-Btu GAS TEMPERATURE

Scheme	*TG3*
29-69A-21	802.0000
29-69A-22	813.0000
29-69A-23	852.0000
29-69A-24	855.0000
29-69A-25	774.0000
29-69A-26	788.0000
29-69A-27	800.0000
29-69A-28	832.0000
29-69A-29	870.0000

PARAMETERS
TG3 — Low Btu gas temperature entering rig (°F)

TABLE A-7
SPECIAL PARAMETERS — COOLING SCHEME DATA

Scheme	*DPCO*	*DPSW*
29-73A-7	1.0000	1.5000
29-73A-8	0.9000	1.4000
29-73A-9	1.0000	1.5000
29-73A-10	1.0000	1.5000
29-73A-11	1.0000	1.5000
29-73A-12	1.9000	2.4000
29-73A-13	2.0000	2.5000
29-73A-14	2.0000	2.5000
29-73A-15	2.0000	2.5000
29-73A-16	2.0000	2.5000
29-73A-17	2.8000	3.2000
29-73A-18	2.8000	3.2000
29-73A-19	2.8000	3.3000
29-73A-20	2.8000	3.2000
29-73A-21	1.3000	1.9000
29-73A-22	1.2000	1.8000
29-73A-23	1.2000	1.8000
29-76A-1	0.9000	
29-76A-2	0.9000	
29-76A-3	0.9000	
29-76A-4	0.9000	
29-76A-5	1.3000	
29-76A-6	1.3000	
29-76A-7	1.1000	
29-76A-8	2.0000	
29-76A-9	2.0000	
29-76A-10	2.0000	
29-76A-11	2.0000	
29-76A-12	2.7000	
29-76A-13	2.6000	
29-76A-14	2.4000	
29-76A-15	2.0000	
29-76A-16	2.0000	
29-76A-17	2.0000	
29-76A-18	2.0000	

PARAMETERS
DPCO — Total to static pressure differential within cooling passage (in. Hg)
DPSW — Plenum total to primary zone static pressure differential (in. Hg)

TABLE A-8
SPECIAL PARAMETERS — AERO/THERMAL FLOW MODELING DATA

Scheme	*DPS4*	*DPSW*	*DPDI*	*DPDU*
29-77A-30	1.9000	2.3000	2.7000	3.9000
29-77A-31	3.0000	3.7000	4.1000	6.3000
29-77A-32	4.0000	4.8000	5.3000	8.3000
29-77A-33	1.7000	2.1000	2.3000	3.5000

PARAMETERS
DPS4 — Plenum total to static pressure differential at station 4 (in. Hg)
DPSW — Plenum total to static pressure differential at station 1 (in. Hg)
DPDI — Plenum total to static pressure differential at station 2 (in. Hg)
DPDU — Plenum total to static pressure differential at station 3 (in. Hg)

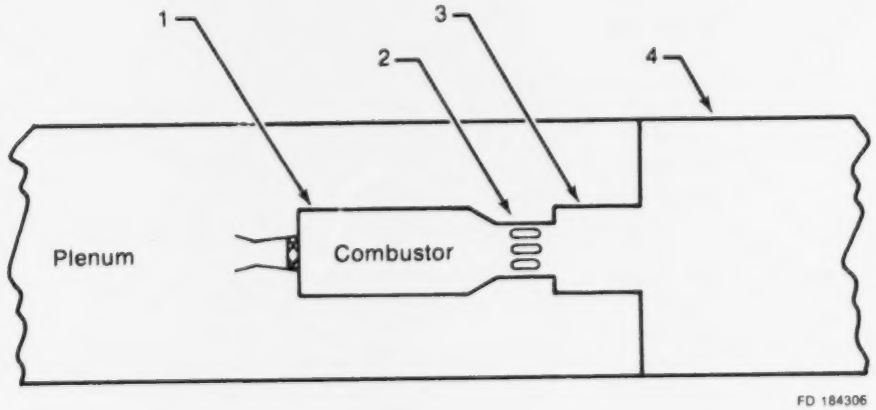


TABLE A-9
SPECIAL PARAMETERS — SMOKE DATA

Scheme	*Smoke*
29-32A-2	3.0
29-33A-5	3.7
29-33A-10	0.3
29-33A-11	2.3
29-37A-13	5.7
29-71A-34	3.5
29-71A-36	3.3
29-71A-38	1.8

PARAMETERS
Smoke — VonBraun Smoke Number

APPENDIX B
LOW-BTU GAS EXPERIMENTS

Several configurations of the bench-scale combustor were tested while firing low-Btu gaseous fuel. The initial tests were performed in the evaluation of Concept No. 1, Low Intensity Flame. Scheme 1-4B, shown in figure B-1, was utilized in an initial series of shakedown tests to verify proper functioning of the rig. Systems and burner components. Highlights of the program conducted were as follows:

1. Low-Btu gas tests were conducted successfully at ambient pressure conditions and at 200 psia.

2. Successful functioning of the low-Btu gas heat exchanger was not achieved due to inadequate flame stability characteristics of the liquid fuel fired heat exchanger combustor. Hence, all tests with low-Btu gas were conducted with ambient temperature fuel gas. A revised heat exchanger combustor configuration was designed, based on diagnostic tests conducted during the test program, and used in later testing.

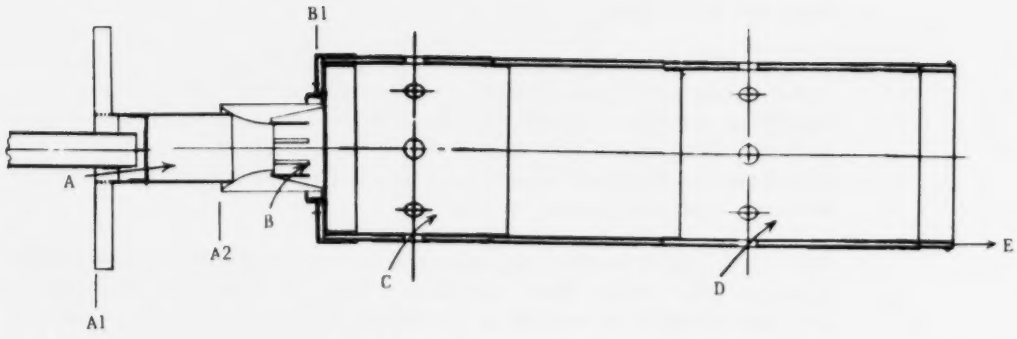
3. The first batch of low-Btu gas was prepared in the modified, roadable, high-pressure tube trailer. Each constituent gas was added until its partial pressure satisfied the desired molar composition in the final mixture. The mixture was then allowed to equilibrate until a homogeneous system was achieved. The approach of the mixture to equilibrium was measured by periodically measuring the composition of carbon dioxide. When the composition of this "tracer" gas remained constant for a series of consecutive analyses, the gaseous system was considered to be completely mixed.

   The molar composition of the first low-Btu gas mixture, by gas chromatography, is shown in Table B-1.

In subsequent parts of the bench-scale program, further tests were conducted with low-Btu gaseous fuel, in conjunction with Concept No. 11, Distributed Flame, and Concept No. 29, Rich Burn/Quick Quench. Discussions of these tests may be found in sections 3.3.11 and 3.3.29. Improvements in the functioning of the heat exchanger were completed to allow the final tests to be conducted with heated gaseous fuel. Limited experimentation in the final test series was also carried out using heated low-Btu gas with ammonia.

Table B-1. Low-Btu Gas Composition

Constituent	*Molar Concentration (Percent)*
H_2	13.17
CO	22.60
CH_4	0.63
CO_2	7.85
N_2	55.75



LB	AREF	L/D	VOLREF	ACDSUM
27.50	19.09	5.56	305.4	3.65

STATION	AX	ACD
A	1.331	1.099
A1	2.924	0.0
A2	4.586	0.0
B	19.079	0.162
B1	19.079	0.0
C	19.079	0.974
D	19.079	1.179
E	19.079	0.241

Figure B-1. Bench-Scale Combustor Scheme 1-4B

APPENDIX C

As part of EPA Contract 68-02-2136, Pratt & Whitney Aircraft, Government Products Division, agreed to experimentally test a platinum-coated catalytic burner developed by Acurex Aerotherm under EPA contract. Under the terms of the agreement, Acurex provided all of the burner hardware including the fuel injectors, premix section, and catalytic burner. P&WA agreed to test this catalytic burner in the bench-scale test facility and also to provide an alternative fuel injection/premixing system.

The purpose of testing at P&WA was to obtain emission data at pressures of three, five and ten atmospheres using gaseous propane, No. 2 distillate fuel oil, and No. 2 fuel oil with pyridine (simulating 0.5% fuel bound nitrogen). The emission data was used to determine the pressure effect on the catalytic burner and also used to verify previous data obtained by Acurex, thereby advancing the development of catalytic burners in general.

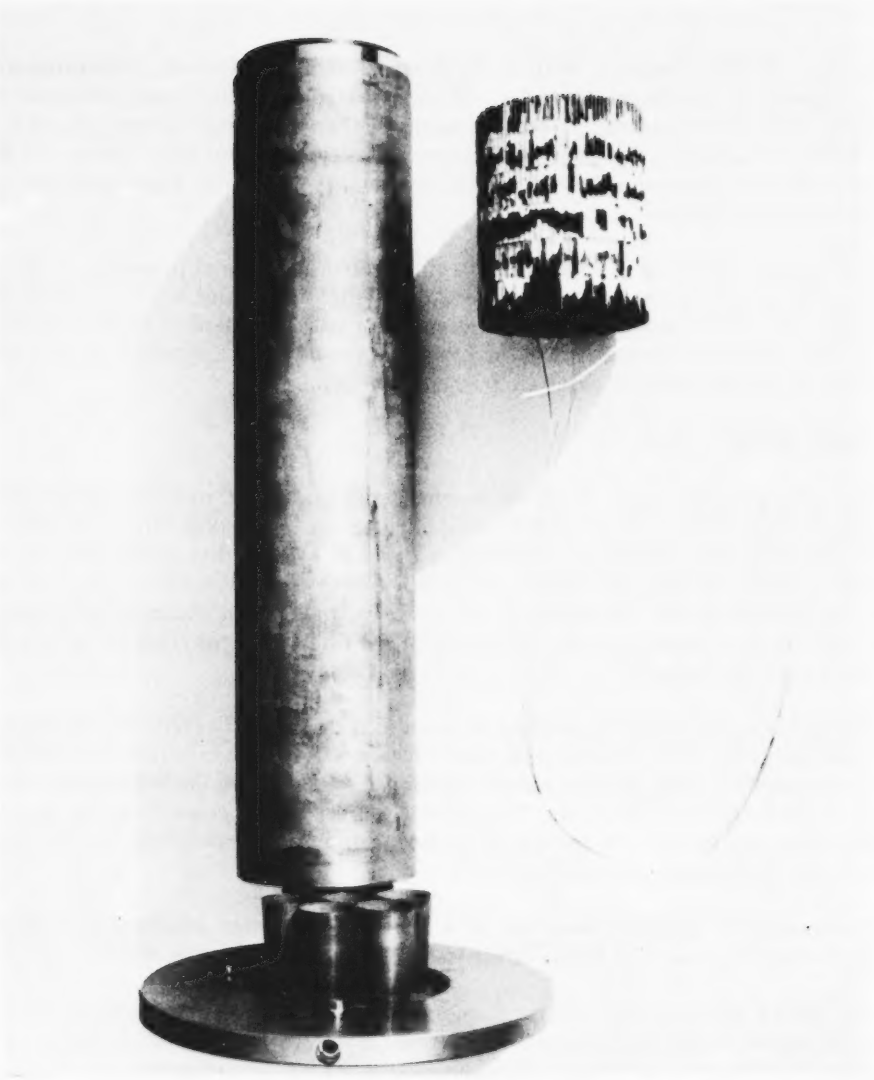
TEST HARDWARE

The ceramic honeycomb structure of the catalytic burner was fabricated into sections approximately one inch thick. Six of the five-inch diameter honeycomb structures were cemented together into a stacked arrangement (see Figure C-1 of this Appendix) so that the cell size of each successive honeycomb segment decreased in the downstream direction. This gave an overall burner length of six inches. The ceramic structure was coated with platinum which served as the catalyst for the combustion process. Three catalytic burners were provided by Acurex during the duration of the test program.

The fuel injection section consisted of seven diffuser tubes (to facilitate the atomization of liquid fuel) mounted in a stainless steel plate. Two modes of fuel injection were provided: axial injection for gaseous propane and radial injection for liquid fuel. In both modes the fuel was injected at the entrance of the tubes. This scheme was selected because it equally distributes the fuel and air so that a uniform premixed mixture can enter the catalytic burner. Some of the details of this part can be seen in Figure C-2 of this Appendix.

The premixing passage consisted of a five-inch diameter stainless steel section. The catalytic burner was installed at the downstream end of the premixing section.

The P&WA alternative injection/premix section is presented in Figure C-3. It consisted of an annular swirler, radial fuel injectors downstream of the swirler, a converging annulus to reduce the possibility of flameholding, and a long premixing conical diverging section (half angle of 2.5 degrees). This concept had been tested previously as Scheme 26-3A with the results indicating that this was a very uniform premixed system.



FC 38584

Figure C-1. Photograph of Acurex/Aerotherm Catalytic Burner Hardware

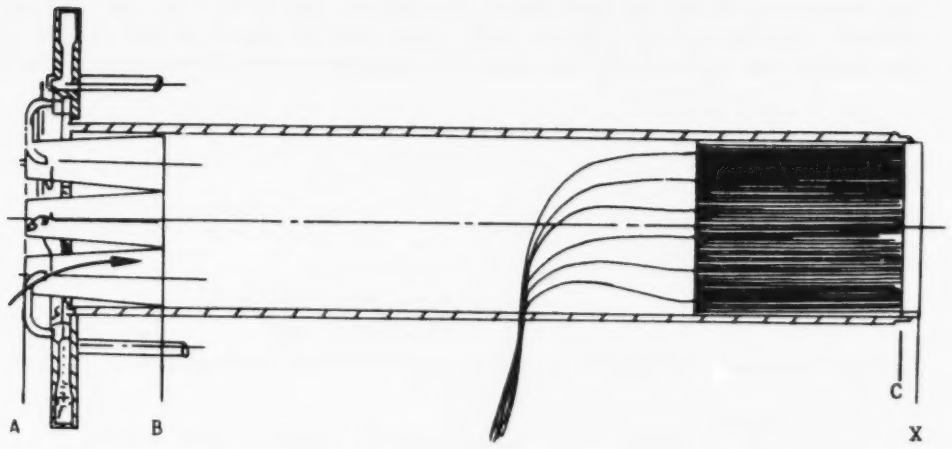


Figure C-2. Acurex/Aerotherm Catalytic Combustor (Scheme 2-1A/B)

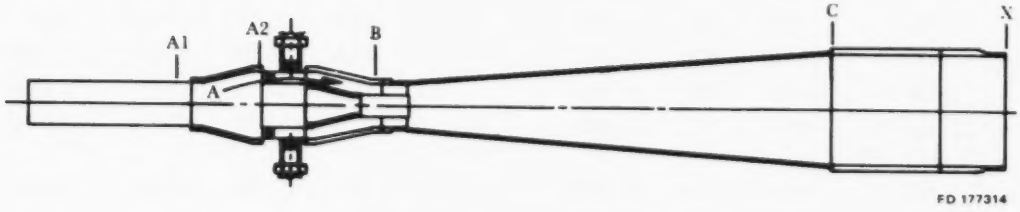


Figure C-3. P&WA Alternate Injection — Premix Scheme 26-3A

TEST RESULTS

The data obtained from the catalytic burner are presented in Tables C-1, C-2, and C-3 of this Appendix, and also are tabulated in Appendix A. Test point 2-1A-1 was taken with the first catalyst. Test points 2-1B-2 through 2-1B-7 were with the second catalyst and the third catalyst was used for the remainder of the points. All emissions reported were corrected to 15% O_2.

TABLE C-1
CATALYTIC BURNER DATA
(Flow Conditions)

Test Point No.	*Inlet Air Pressure psia*	*Inlet Air °F*	*Air Flow lb_m/sec*	*Combustor ΔP psid*	*Fuel Flow lb_m/hr*	*Fuel Temp °F*	*Fuel Air Ratio*	*Equivalence Ratio*	*Fuel Type*
2-1A-1	46.0	699	0.1916	0.4	2.5*	228	-	-	Propane
2-1B-2	45.0	703	0.2240	0.1	16.5*	154	0.0205	0.3203	Propane
2-1B-3	73.0	722	0.2288	-	15.1*	154	0.0183	0.2859	Propane
2-1B-4	73.0	711	0.2290	-	18.6*	162	0.0226	0.3531	Propane
2-1B-5	99.5	723	0.2561	-	14.87	134	0.0161	0.2516	Propane
2-1B-6	147.5	829	0.5964	-	27.24	162	0.0127	0.1984	Propane
2-1B-7	45.5	679	0.1945	-	13.75	98	0.0196	0.3063	Propane
2-1B-8	44.0	894	0.4098	-	11.8	75	0.0080	0.1163	No. 2
2-1B-9	44.5	901	0.4148	-	13.7	76	0.0092	0.1337	No. 2
2-1B-10	76.5	819	0.9150	-	27.5	78	0.0083	0.1206	No. 2
2-1B-11	103.0	681	1.2804	-	38.5	78	0.0084	0.1221	No. 2
2-1B-12	42.5	881	0.3931	-	7.7	78	0.0054	0.0785	No. 2W/ Pyridine
2-1B-13	45.0	778	0.4146	-	20.9*	67	0.0140	0.2035	No. 2W/ Pyridine
2-1B-14	74.5	754	0.8014	-	34.0	69	0.0118	0.1715	No. 2W/ Pyridine
2-1B-15	99.5	746	0.9938	-	43.0	69	0.0120	0.1744	No. 2W/ Pyridine

*Approximate Flow: Test No. 2-1A-1 → Questionable
2-1B-2 thru 4 and 13 → Determined from ideal O_2 Curve

NOTE: No. 2 Fuel W/Pyridine contains 0.5% Nitrogen by Weight

TABLE C-2
CATALYTIC BURNER DATA
(Emissions)

Test Point No.	*FA*	*UHC* PPMV*	*CO_2 PCTV*	*CO* PPMV*	*O_2 PCTV*	*NO_x* PPMV*	
2-1A-1	-	2.9**	6.15	12.0**	11.4	281.0**	
2-1B-2	0.0205	0.6	5.16	9.2	13.5	2.2	
2-1B-3	0.0184	0.3	4.60	9.2	14.3	1.2	
2-1B-4	0.0226	0.0	5.41	8.4	12.7	1.8	
2-1B-5	0.0161	0.4	4.00	129.1	15.7	0.8	
2-1B-6	0.0127	0.0	3.38	34.2	16.2	1.0	
2-1B-7	0.0196	0.6	4.28	8.7	14.9	0.2	
2-1B-8	0.0080	187.8	2.57	2823.2	16.9	7.3	
2-1B-9	0.0092	71.3	2.92	1458.6	16.3	10.3	
2-1B-10	0.0083	54.4	2.65	3625.2	16.0	7.7	
2-1B-11	0.0084	500.8	2.23	4954.5	16.2	5.9	conversion
2-1B-12	0.0054	-	1.88	6510.0	16.7	155.4	81%
2-1B-13	0.0140	108.1	4.18	110.7	15.2	195.3	99%
2-1B-14	0.0118	39.1	3.42	2058.1	16.0	118.8	62%
2-1B-15	0.0120	24.6	3.27	2145.2	16.2	107.4	56%

* Corrected to 15% O_2
**Uncorrected Values

TABLE C-3
CATALYTIC BURNER DATA
(Temperatures)

Test Point No.	*Down-Stream 1" Behind Burner °F*	*Down-Stream 12" Behind Burner °F*	*Catalyst Bed Temp 1 °F*	*Catalyst Bed Temp 2 °F*	*Catalyst Bed Temp 3 °F*
2-1A-1	2155	1570	-	-	-
2-1B-2	-	1800	-	-	-
2-1B-3	-	1700	-	-	-
2-1B-4	-	1820	-	-	-
2-1B-5	-	1420	-	-	-
2-1B-6	-	1660	-	-	-
2-1B-7	-	1610	-	-	-
2-1B-8	-	1030	1226	1305	1693
2-1B-9	-	1090	1280	1401	1857
2-1B-10	-	1070	1293	1423	1839
2-1B-11	-	950	1102	1208	1506
2-1B-12	-	930	1185	-	-
2-1B-13	-	1080	-	-	-
2-1B-14	-	1050	-	-	-
2-1B-15	-	1070	-	-	-

The following points are the major conclusions drawn from testing the Acurex catalytic combustor at P&WA:

1. Emission data were obtained with propane at three, five, seven and ten atmospheres of pressure at catalytic bed temperatures around 2000°F. Low emission values of NO_x, CO and UHC were generally recorded (less than 10 ppm corrected to 15% O_2).

2. Because of upstream flameholding problems, emission data with No. 2 Fuel Oil were obtained only at pressures of three, five and seven atmospheres. The airflow required to eliminate upstream flameholding was so large that the catalytic burner was only partially reacting. Bed temperatures were somewhat on the low side (less than 1850°F). This resulted in high CO and UHC emissions. NO_x emission values remained low (less than about 10 ppmv corrected to 15% O_2).

3. Similar problems occurred with the No. 2 Fuel Oil with pyridine. Emission data were obtained at three, five and seven atmospheres at relatively low bed temperatures (less than 1850°F). High CO and UHC emissions were recorded. The percent of fuel bound nitrogen converted to NO_x was affected by burner pressure, reaching a low value of 56% at 100 psia, as seen in Figure C-4 of this Appendix.

4. The P&WA premix section was successfully tested without the catalytic burner at the reduced airflows required by the catalytic burner (see results of Scheme 26-3A). Because of time limitations, it was not tested with the catalytic burner. It appears to be a promising concept especially in view of the upstream flameholding encountered in this program.

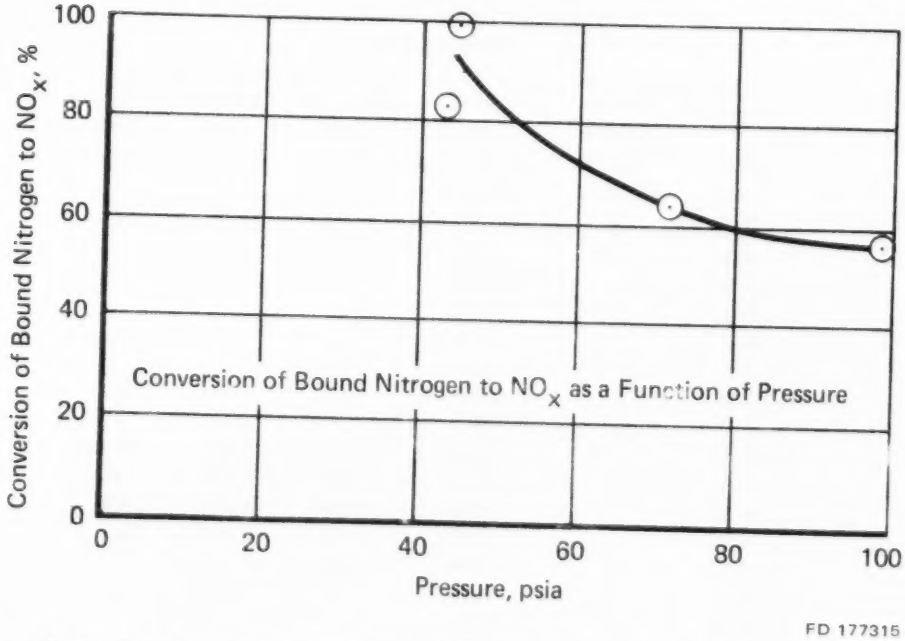


Figure C-4. Conversion of Bound Nitrogen to NO_x as a Function of Pressure

APPENDIX D
SI UNITS CONVERSION TABLE

English	*SI*	*Multiply By*
°F	°K	K = (5/9) (F + 459.67)
in.	cm	2.54
cu ft	m^3	0.0283
ft/sec	m/sec	0.3048
in. Hg	N/m^2	3.3863
lb_m/sec	kg/sec	0.4535
lb_m/hr	kg/hr	0.4535
gal	m^3	0.003785
Btu/hr/atm/ft^3	J/hr/(N/m^2)/m^3	0.03675
psi	N/m^2	6894.7572